FOREST *INSECT AND DISEASE* CONDITIONS IN THE UNITED STATES

1973

FOREST SERVICE

U.S. DEPARTMENT

OF AGRICULTURE

PSW FOREST AND RANGE
EXPERIMENT STATION

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FOREWORD

This annual report on forest insect and disease conditions is compiled in the Washington Office, Division of Forest Pest Control, State and Private Forestry. It is made possible through the contributions of professional forest entomologists and pathologists throughout the country. The report is intended to give the reader a brief description of the status of forest insect and disease outbreaks on lands of all ownerships. The objective is to provide continuity, from one year to the next, about the trends of pest outbreaks. Pertinent investigations, closely aligned with the insect and disease conditions, are also reported.

A substantial portion of the information comes to the entomologist and pathologist through a wide variety of sources—the interested camper, tourist, permittee, etc., and a broad-based net of professional foresters and land managers. This is referred to in pest management as an ongoing pest surveillance system. A surveillence system is essential in the early detection of pest outbreaks. Most of the information reported here is accumulated through systematic aerial and ground surveys designed to either detect outbreaks or to provide data for evaluating the biological potential of an outbreak. Detailed information on pest population trends are determined by indepth evaluations of the critical life stages of the pest, its natural enemies, and the host itself.

Early detection and meaningful evaluation of insect infestations and disease infections will, without question, become increasingly important components of pest management. A real opportunity exists in reducing the Nation's forest resource losses caused by insects and diseases; early detection is one means. In addition to reducing the estimated 9 billion board feet annual loss caused by insects and diseases, accurate and useful detection and evaluation data are absolutely essential to assist the land manager in making highly important decisions affecting forest resource management. The critical nature of these decisions is emphasized when pesticides become necessary to deal with outbreaks.

The importance of meaningful detection and evaluation data has been brought home more clearly than ever with the tremendous infestations of the spruce budworm, gypsy moth, southern pine beetle, mountain pine beetle, and Douglas fir tussock moth during 1973. Not only is each of these infestations at or near the highest level ever recorded, but Federal, State, and private forest interests have expended more money and manpower during this period than at any comparable time in the past to deal with these problems. Control decisions are agonizingly difficult to make because of economic and environmental considerations. The burden of these decisions can and must be eased by providing the needed detection and evaluation information to the decision-maker.

In most instances, detailed reports on each insect or disease condition mentioned in this publication can be provided by the regional author(s). Persons desiring more details on these insect and disease conditions should contact the regional authors directly.

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Cover photos: Front cover, armillaria root rot fruiting body; back cover, Douglas fir tussock moth larva.

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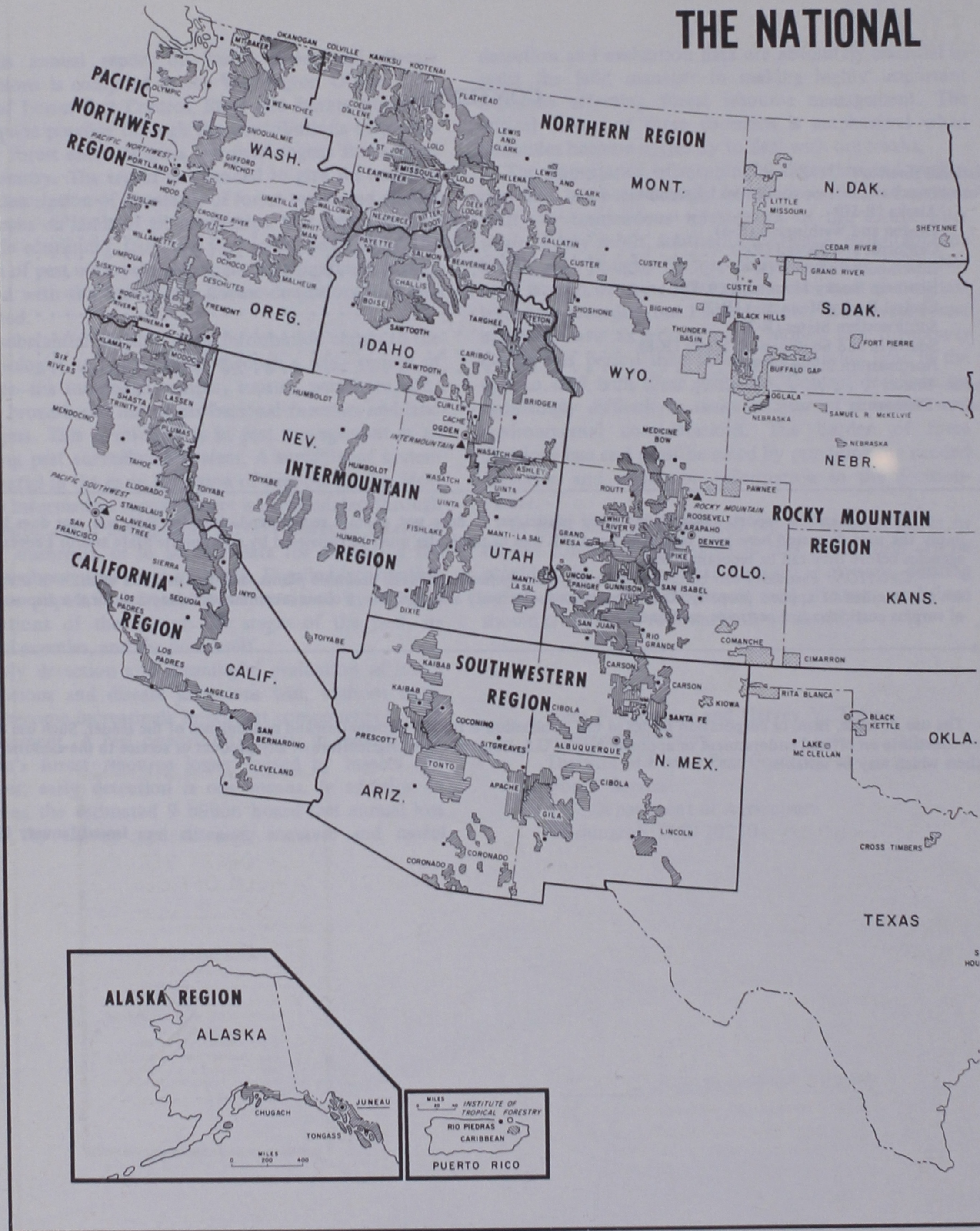
This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

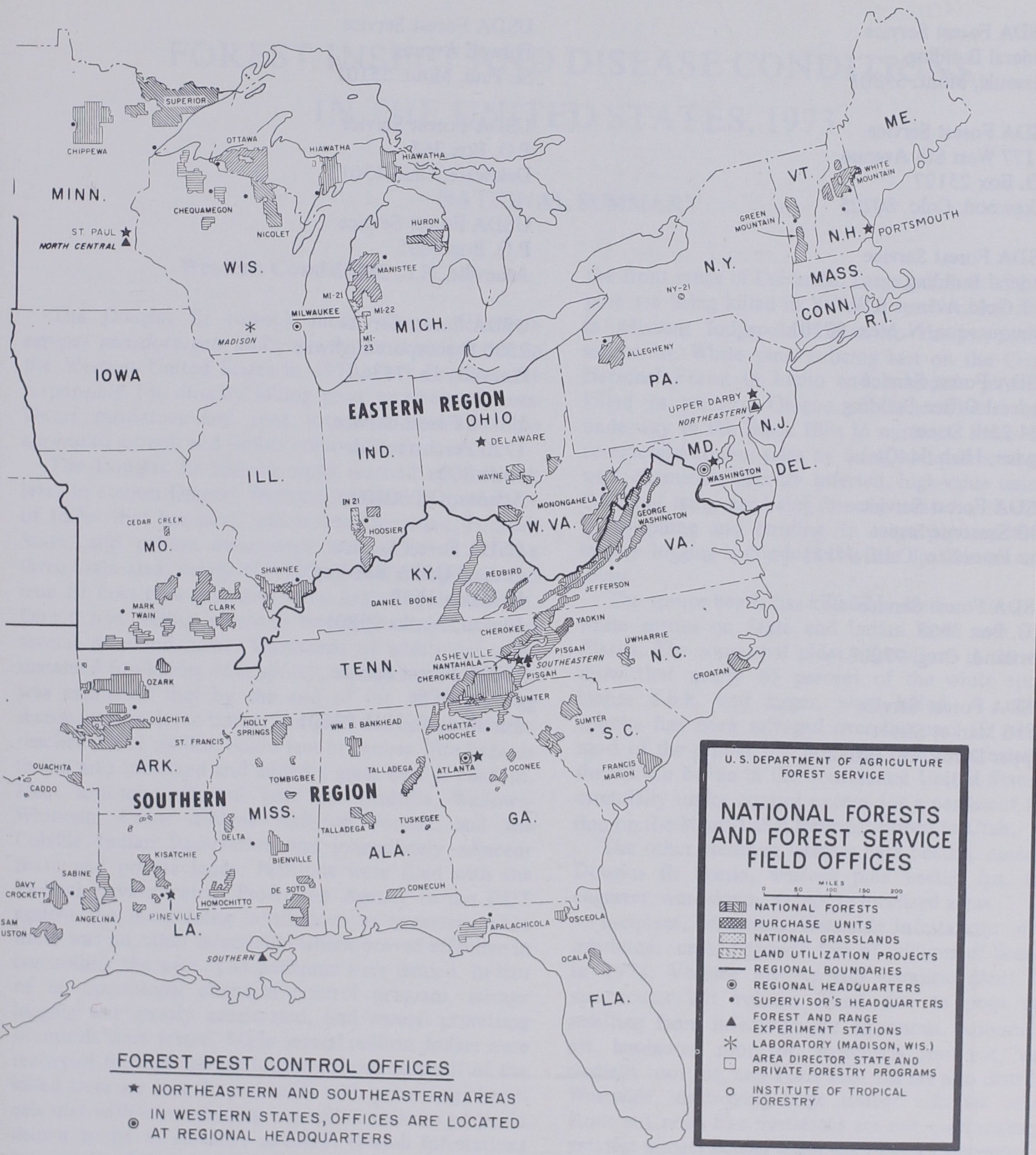
The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Issued January 1975

THE NATIONAL



FOREST SYSTEM



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★ NORTHEASTERN AND SOUTHEASTERN AREAS

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FOREST INSECT AND DISEASE CONDITIONS IN THE UNITED STATES, 1973

NATIONAL SUMMARY

Western Conditions

The Douglas fir tussock moth, *Orgyia [Hemerocampa] pseudotsugata* McD, was the most serious pest in the Western United States in 1973. Bark beetles were responsible for directly killing great numbers of trees. Dwarf mistletoes and root rots continued to cause enormous growth and timber volume losses.

The Douglas fir tussock moth reached an outbreak level in eastern Oregon, Washington, and the panhandle of Idaho that has never before been recorded. Federal, State, and private ownerships were affected. In the three-State area, nearly 800,000 acres of Douglas-fir and true fir host type sustained some degree of defoliation. Direct tree killing of many host-type stands totalled several thousand acres. Thousands of additional acres sustained top-killing with spotty, outright tree killing. It was estimated that by the end of the 1973 growing season, accumulated timber and growth losses in the area reached 1,001 million board feet of timber. Fire hazards in the area increased and added a great deal of concern. Most seriously affected were the Umitilla, Wallowa-Whitman, Coeur d'Alene National Forests, and the Colville Indian Reservation and immediately adjacent State and private lands. Petitions were filed with the Federal Environmental Protection Agency to use DDT against the threatening infestations as necessary since there was no other insecticide which proved effective in controlling the pest. The petitions were denied. In lieu of an operational chemical control program, salvage logging was greatly accelerated, and several promising chemicals were tested. While several million dollars were recouped through salvage logging, about one-half of the killed trees are lost. Experiments with promising chemicals met with some success, but still there is no pesticide shown to be as effective as DDT. Overall infestations have declined, but new infestations are expected. About 650,000 acres will probably sustain some degree of defoliation in 1974.

The mountain pine beetle alone killed about 4 million lodgepole, ponderosa, and white pine in the Western United States. The largest outbreaks occurred in ponderosa pine in the Black Hills of South Dakota and along the front range of Colorado. Large numbers of lodgepole pine are being killed in Yellowstone National Park, and in adjacent lodgepole forests to the northwest and southwest. White pine is being lost on the Clearwater National Forest in Idaho and lodgepole pine is being killed in western Oregon. A concentrated effort is underway in the Black Hills to minimize losses through commercial timber sales by using some direct treatment with chemicals. Heavily infested, high-value units along the front range are being directly treated with chemicals or by piling and burning. In other parts of the West, salvage logging is conducted where feasible to minimize losses.

The spruce beetle has killed hundreds of thousands of white spruce on State and Indian lands near Tyonek, Alaska. The somewhat older infestations in the vicinity show that nearly 65 percent of the white spruce, 5 inches d.b.h. and larger, were killed. A substantial volume has been salvaged over the past 10 years, but most of the timber will probably be lost. Infestations of the spruce beetle in the continental United States were essentially under control except for a persistent infestation on the Manti-LaSal National Forest in Utah.

The other common western bark beetles, namely the Douglas fir beetle, western pine beetle, *Ips,* and fir engraver, were down, except in localized areas.

Incipient, essentially Westwide infestations of dwarf mistletoe, caused growth loss of millions of board feet in 1974. Volume lost to this parasitic plant is not spectacular but volume losses due to poor growth resulting from infections are enormous. Annosus root rot, laminated root rot, Armillaria root rot, Verticicladiella root rot, and Poria root rot are also distributed Westwide, destroying large timber volumes annually. Root rot pests like mistletoes are not spectacular; their greatest impact occurs when the trees are harvested.

The western spruce budworm defoliated, in varying degrees, nearly 3.5 million acres in Montana and Idaho in 1973, which is a substantial decrease from that infested in 1972. In Oregon, Washington, California, Arizona, New Mexico, and Colorado western budworm infestations seem to be increasing. Of considerable interest is the rather significant increase of the green

form of the western budworm in California. The larch casebearer continues to cause heavy defoliation of larch in lower elevations in northern Idaho, northwestern Montana, and eastern Washington.

The Dutch elm disease has been detected for the first time in the States of Oregon and Montana. Foliage diseases were common in several Western areas, particularly the needle cast fungi. Nursery disease appeared more common in 1973 than in 1972. Infections were noted in nurseries in Idaho, Washington, and Colorado. Western gall rust and white pine blister rust continued as serious problems in certain locations. Abiotic diseases due to air pollution, drought, and winter burn were generally increasing throughout the West in 1973.

Eastern Conditions

The southern pine beetle, gypsy moth, and spruce budworm were at or near record levels in the Eastern United States in 1973. Dutch elm disease, Scleroderris canker, and beech bark disease were the primary disease problems.

The southern pine beetle outbreak set new record levels of infestations in the loblolly shortleaf pine type, extending from Virginia to east Texas. About 47 million acres of commercial forests are infested to some degree. There were concentrated efforts by State, private, and Federal agencies to mitigate timber losses and suppress populations of the insect. The principal means of control has been the removal of infested trees by commercial timber sales. This activity produced more than 250 million board feet of sawtimber and 42 million cubic feet of pulpwood from infested, dead, and dying trees. There is no indication that overall conditions will be better in 1974, although there are signs that high-infestation centers are shifting.

The gypsy moth expanded its range and defoliation intensified in the Northeastern United States. Varying degrees of defoliation were recorded on nearly 1.8 million acres of central hardwood forests. The largest increase was in Pennsylvania where about one-half of the damage occurred. Infestations also increased in Rhode Island and Massachusetts. Connecticut infestations are decreasing and those in New York and New Jersey appear to be stabilizing. Gypsy moth population collapses are common after 2 or 3 years of natural population cycle. Intensive surveys by the Animal and Plant Health Inspection Service using pheromone-baited traps have caught male adults in many counties outside of the generally infested zone. Infestations outside of the quarantine area have been discovered in central lower Michigan, at Hungry Mother State Park in Southern Virginia, and in the Winston-Salem area of North Carolina.

The spruce budworm in Maine covered about 2.5 million acres. The outbreak is in its third year with no signs of natural decline. Conditions are favorable for the budworm in the Northeast, as millions of acres in Ontario, Quebec, New Brunswick, Minnesota, and Maine are affected. A suppression project in Maine covered about 450,000 acres of seriously infected spruce-fir forests in five different locations. Suppression activities are planned for additional areas in Maine and a tract of State-owned lands in Minnesota in 1974. Other defoliating insects were the major cause of concern in the Northeast; of most significance was the cherry-scalloped shell moth in Pennsylvania. Pine seed and cone insects continued as a major pest problem in the Southeast.

Dutch elm disease continued to cause heavy tree killing and significant economic loss in the Northeastern section of the country. Many localized areas are depleted of most elms and as a result the disease has lost much of its pest significance. The disease is causing its greatest damage as it moves into previously uninfected areas where the American elm is a dominant component of the rural and community forest.

Serious damage caused by Scleroderris canker has been sustained in many red and Scotch pine plantations in upstate New York. Infection centers are apparently continuing to spread in the region.

Beech bark disease has continued its relentless spread through the American beech stands of New England and New York. Millions of commercial-sized beech have been killed over the past several years. There is no reason to believe that the disease will not spread throughout the host range leaving what now appears as severely depleted, inferior stands of small or badly damaged beech.

Annosus root rot and other root rot diseases continue to be serious pests in many forest stands in the Southern and Southeastern States. Oak wilt and white pine blister rust continued in about the same locations and at the same levels as in 1972.

FOREST INSECT AND DISEASE CONDITIONS BY REGIONS

ALASKA (R-10)

by

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Conditions in Brief

A discussion of annual forest insect and disease conditions in Alaska deserves a comment on surveillance intensity. As is true elsewhere, systematic detection surveys are designed to complement reports of insect and disease situations submitted by land managers and others recently returned from the "bush." There are approximately 119 million acres of "forest land" in the State, 28 million of which is classed as having commercial timber. Much of the commercial timber has not yet become economically marketable and little of that which is marketable is managed intensively. The State's road system is limited in extent and staffs of many land management agencies are small compared to their counterparts in the lower 48 States. It follows that intensity and precision of insect and disease detection varies according to accessibility, forest management intensity, and public concern for a particular forested area. Surveys range from intensive air and ground detection and evaluation efforts to occasional flights over vast areas of remote noncommercial taiga. Survey priorities must be adjusted to land management priorities, yet some documentation is needed of conditions in remote areas to aid us now and in the future. When one speaks of insect infestations or disease conditions in Alaska, he speaks of known infestations and conditions. A goal is to increase survey intensity each year. Success toward that goal involves the efforts of Forest Service insect and disease specialists and field-going personnel of all land managing agencies.

Spruce beetle infestations continued to draw attention in the Cook Inlet basin. Some populations declined due to host depletion, others expanded or intensified. Hemlock sawfly and western black-headed budworm populations were most prevalent near Ketchikan. Renewed ips beetle activity in white spruce was recorded along the Yukon and Porcupine Rivers. Principal disease activities were suppression and evaluation efforts in western hemlock stands infected by dwarf mistletoe and cooperative updating of cull factor data in southeast Alaska forests. Locations of significant insect and disease outbreaks are shown on the index map of Alaska (fig. 1).

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). This insect remained a focal point in Alaska during 1973. Aerial observations and field data indicated that the infestation on State and Indian lands near Tyonek, while declining in areas of heavy stand depletion, was continuing in stands that contained sufficient host-tree material. The Tyonek infestation covered 103,000 acres in 1973 (fig. 2). Heaviest current beetle concentration exists between the McArthur and Chakachatna Rivers. The area immediately north of the Tyonek Indian Reservation and Congahbuna Lake has an increasing accumulation of dead white spruce. The density of trees attacked, however, is closely related to the scattered and dispersed host type in that area. Increased tree mortality was also recorded along the Beluga River southeast of Beluga Lake. The original portion of the infestation in the vicinity of Stedatna Creek has declined.

The spruce beetle periodically causes heavy damage in Alaska's white spruce stands. In an effort to determine the extent of damage, the 20-square-mile Stedatna Creek area of formerly heavy infestation was sampled. It was found that 65 percent of white spruce of 5 inches d.b.h. and larger had been killed. Detailed results of that study are forthcoming. The percentage of white birch in the stand became substantially greater following the outbreak.

A limited sample of spruce killed early in the infestation was sent to the Forest Products Laboratory in Madison, Wis. Cooking characteristics of the wood and strength properties of the pulp from dead spruce were good compared to green spruce. If the limited samples evaluated are representative of other beetle-killed trees, little problem is anticipated in the manufacture of high quality kraft or sulphide pulps. Dead trees are not as suitable for lumber because blue stain present in the sapwood is less acceptable in this industry.

In 1973 the State Division of Lands consummated a 10-year salvage sale near Tyonek that covered 223,000

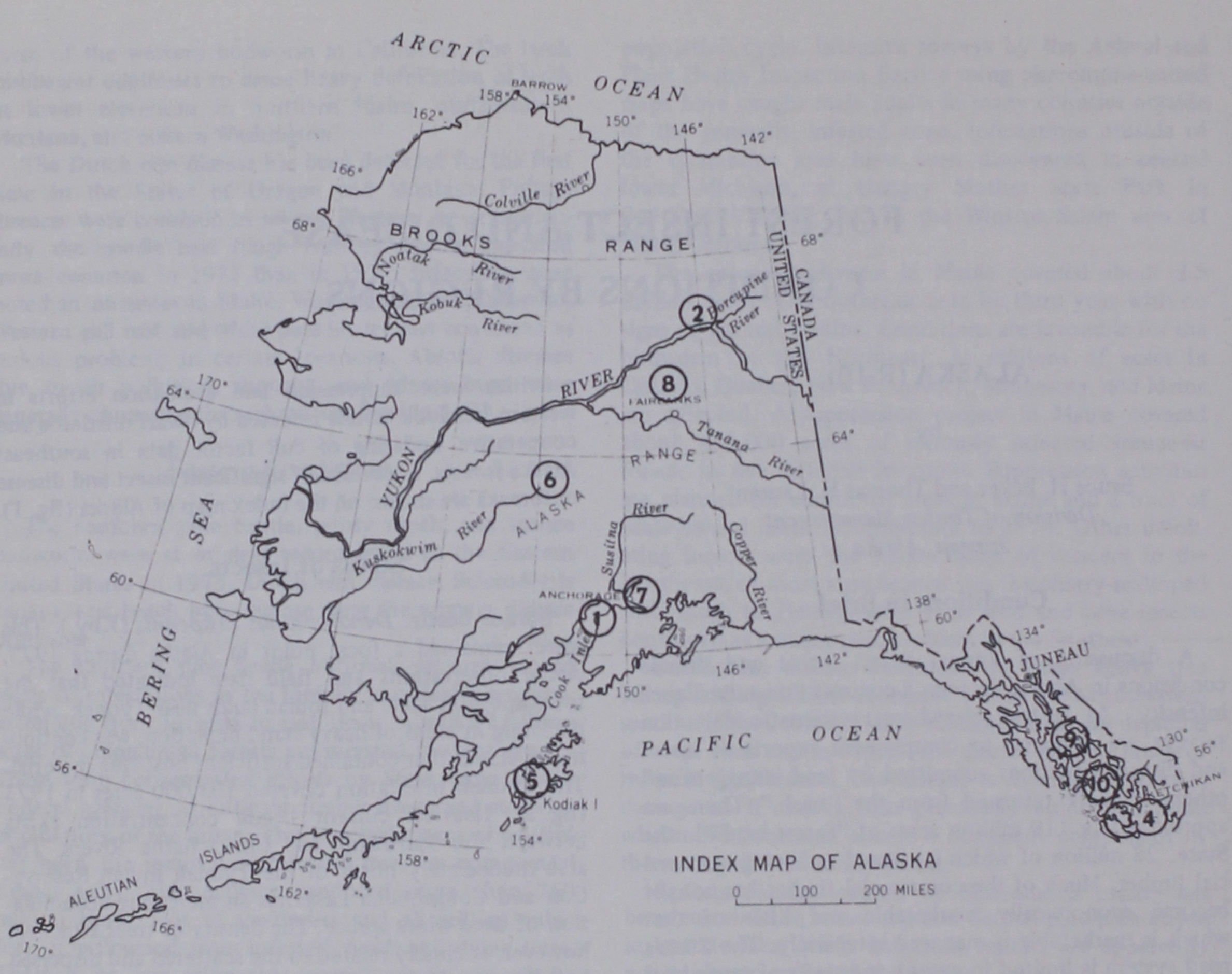

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Figure 1.–Forest insect and disease conditions in Alaska in 1973. 1) Spruce beetle, 2) ips beetle, 3) hemlock sawfly, 4) western black-headed budworm, 5) *Operophtera hyperbeata*, 6) larch discoloration, 7) frost damage, 8) winter drying, 9) hemlock dwarf mistletoe, and 10) shoot blight of hemlock.

acres and a total of 425 million board feet of mixed species. Spruce sawlogs and utility logs comprised 285 million board feet of the sale and the bid price on spruce was $1 per thousand board feet. To facilitate sale layout, the Division of Lands was assisted by the Forest Service, University of Alaska, and others in obtaining full aerial photographic coverage of the sale area. Other efforts in remote sensing of the Tyonek infestation included Earth Resources Technology Satellite (ERTS) imagery coordinated through the University of Alaska's Geophysical Institute. Further cooperation between Institute and Forest Service personnel is planned. Of immediate usefulness in detecting spruce beetle outbreaks in remote areas of the State, is high altitude, small scale, aircraft photography. Despite the fact that coverage is limited at present, existing color infrared photos are capable of revealing outbreaks.

Farther south on the west side of Cook Inlet, spruce beetle activity occurred in Sitka spruce. The outbreak was near Red Glacier on Bureau of Land Management (BLM) lands. An intensive aerial survey was flown to assist BLM in appraising salvage opportunities. Beetle-infested trees were mapped on 4,190 acres. Additional spruce mortality is expected in both the Tyonek and Red Glacier infestations.

The generally declining beetle populations that were reported on the Kenai Peninsula in 1972 continued to subside. The acreage of active infestation on the Kenai National Moose Range and on State and private lands southwest of Tustumena Lake have declined to approxi-

mately 53,000 acres. The outbreak is intensifying but is not spreading. Remaining activity is concentrated in an area southwest of Turnagain Arm and Chickaloon Bay in the vicinity of Miller Creek, Two-Island Creek, Barbara Lake, and the Swanson Lakes. While some current tree mortality is occurring north of Kenai and west of the highway between Soldotna and Kasilof, damage is relatively light compared to the abundance of previously killed trees in those areas.

A beetle outbreak on Afognak Island in 1933 caused a loss of 150 million board feet of Sitka spruce. In anticipation of a 332-million-board-foot sale on the Chugach National Forest there, a 1973 appraisal of present beetle risk was undertaken. Beetle broods were very low in the few cull logs remaining after a current sale.

Ips beetles, *Ips* spp. An aerial survey was made of Bureau of Land Management lands in an area northwest of Fort Yukon that had historically supported chronic ips beetle populations. The last recorded infestation period in the vicinity of the Porcupine, Coleen, Sheenjek, and Chandalar Rivers occurred in the 1950's. Large expanses of dead white spruce are still apparent from that outbreak. Little surveillance is recorded for the area since that time. This year's survey indicated several years of recent tree mortality along the river bottoms. A prevalent species in the area is *Ips perturbatus* (Eichh.). Ips beetles in the Yukon-Porcupine country tend to build up in flood- or fire-damaged white spruce and then begin attacking healthy trees. The braided river channels that are typical of the area are unstable. Shifting river courses periodically cause numerous bands or arcs of timber to be flooded. This source alone provides for adequate population buildup of ips beetles. The insects are an integral component of the local river bottom ecosystem. There are apparently periods of years when tree mortality becomes higher than average. Also contributing to ips buildup in the area is the construction of seismic lines for petroleum exploration. The significance of these lines as a contributing factor depends upon the extent of area that they traverse. At present beetle buildup is occurring within approximately an eighth of a mile of where seismic lines occasionally pass through blocks of white spruce type. Flooding has apparently been the main cause of the recent infestation. The infestation is discontinuous but occurs over a 1,500-square-mile expanse beginning near the confluence of the Hadweenzic and Yukon Rivers and extending eastward across the Yukon Flats and lower Chandalar River to Fort Yukon, and thence up the Porcupine River to Shuman House and the lower Sheenjek River.

Hemlock sawfly, *Neodiprion tsugae* (Midd.). Sawfly defoliation of western hemlock continued in 1973 in that portion of southeast Alaska south of Sumner Strait. Approximately 13,000 acres of defoliation were observed from the air on National Forest land. On the east side of Prince of Wales Island, defoliation was concentrated in the North Arm of Moira Sound, Port Johnson, Paul Lake, Dutch Harbor, Windy Point, Windfall Harbor, Karta Bay, Dora Bay, and the South and West Arms of Cholmondeley Sound. On Revillagigedo Island, sawfly feeding was conspicuous in Ward and Whipple Creeks, at California Head, and in Thorne Arm and Princess Bay. Several of these areas also supported significant populations of western black-headed budworm. Ward Creek is accessible by road from nearby Ketchikan and supports considerable recreation activity in the summer months. Defoliation there has aroused public attention. Larval counts in 1973 varied, some sample points showing increases over 1972 and others showing a reduction. Egg counts in the fall of 1973 indicated reduced feeding in 1974.

A cooperative study was begun in 1973 to identify stand factors associated with recurring hemlock sawfly outbreaks and to evaluate long-term stand impacts of defoliation, the degree of top-kill, and growth loss. The study involves Forest Service entomologists in both Forest Pest Control and in Forest Insect and Disease Research. An objective is to better assist land managers in scheduling conversion of old-growth stands to second-growth regeneration.

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Figure 2.–White spruce killed by spruce beetle near Tyonek, Alaska.

Western black-headed budworm, *Acleris gloverana* (Wlshm.). An anticipated increase in budworm feeding in 1973 materialized in the southern part of the Tongass National Forest. Although defoliation often was too light to be detected from the air in old-growth stands, larval counts were considerably higher than in 1972 or 1971. Several areas yielding high budworm larval counts were also pockets of intense hemlock sawfly activity. Much of the 13,000 acres of defoliation on Prince of Wales and Revillagigedo Islands included budworm feeding.

Locations on Prince of Wales Island with substantial budworm increases in 1973 were Moira Sound, Dora Bay, and the West Arm of Cholmondeley Sound, and Polk and McKenzie Inlets. Increases also occurred at California Head on Revillagigedo Island and Saks Cove on the mainland. A localized infestation was discovered at the south end of Chilkoot Lake near Haines.

As budworm activity increases, infested areas are being incorporated into a cooperative stand impact measurement study conducted by Forest Service Insect and Disease Control and Research entomologists.

Other insects. Subtle defoliation of deciduous trees and shrubs by a geometrid, *Operophtera hyperbeata* (Hulst), was observed for the second year by Kodiak Island residents. By early August defoliation was reported on much of the Island. Field reports were received from the city of Kodiak, Karluk Lake, Larsen Bay, and nearby Onion Bay on Raspberry Island. Plants principally affected were alder, willow, cottonwood, highbush cranberry, and some elderberry. Occasional Sitka spruce growing beneath deciduous branches also sustained a small amount of damage to buds and new foliage. Although some twig and branch mortality may occur, whole plant mortality is not expected to be common. A second bud break had begun on many plants by mid-August.

Of local interest in the Juneau area were patches of alder defoliation up to an acre in size caused by the striped alder sawfly, *Hemichroa crocea* (Fourcroy). Some defoliation also occurred during the previous 2 years.

Status of Diseases

Hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosend.) G. N. Jones. A total of 350 acres of mistletoe control work was conducted on the Stikine Area of the Tongass National Forest in the Fiscal Year of 1973. Control consisted of removing infected residual trees remaining after logging.

A study to determine growth loss caused by dwarf mistletoe in young growth western hemlock stands (less than 100 years old) was begun in 1973. Infected and otherwise comparable uninfected trees were dissected. A preliminary analysis of data collected will help to determine the future course of the study.

Sirococcus shoot blight, *Sirococcus strobilinus* (Desm.) Petr. This disease was first observed in southeast Alaska at Thomas Bay in 1967. Since its initial discovery it has been found to be well distributed south of Sumner Strait. Thomas Bay remains the "hot spot" with severe growth reduction, deformity, and some mortality occurring in western hemlock reproduction. In a series of plots established by Stikine Area personnel in uninfected hemlock, the infection rate increased from zero to 65 percent in 1 month (fig. 3). Some Sitka spruce saplings at Thomas Bay are showing the shoot blight symptoms. Damage to the spruce is light and the disease may only be doing some natural thinning in this species.

Hemlock canker, *Caliciopsis pseudotsugae* (Fitzpatric). Approximately 3,000 acres of cankered western hemlock was reported at Neck Lake on Prince of Wales Island. The cankers were found to be caused by *C. pseudotsugae.* Understory hemlock were dead or dying

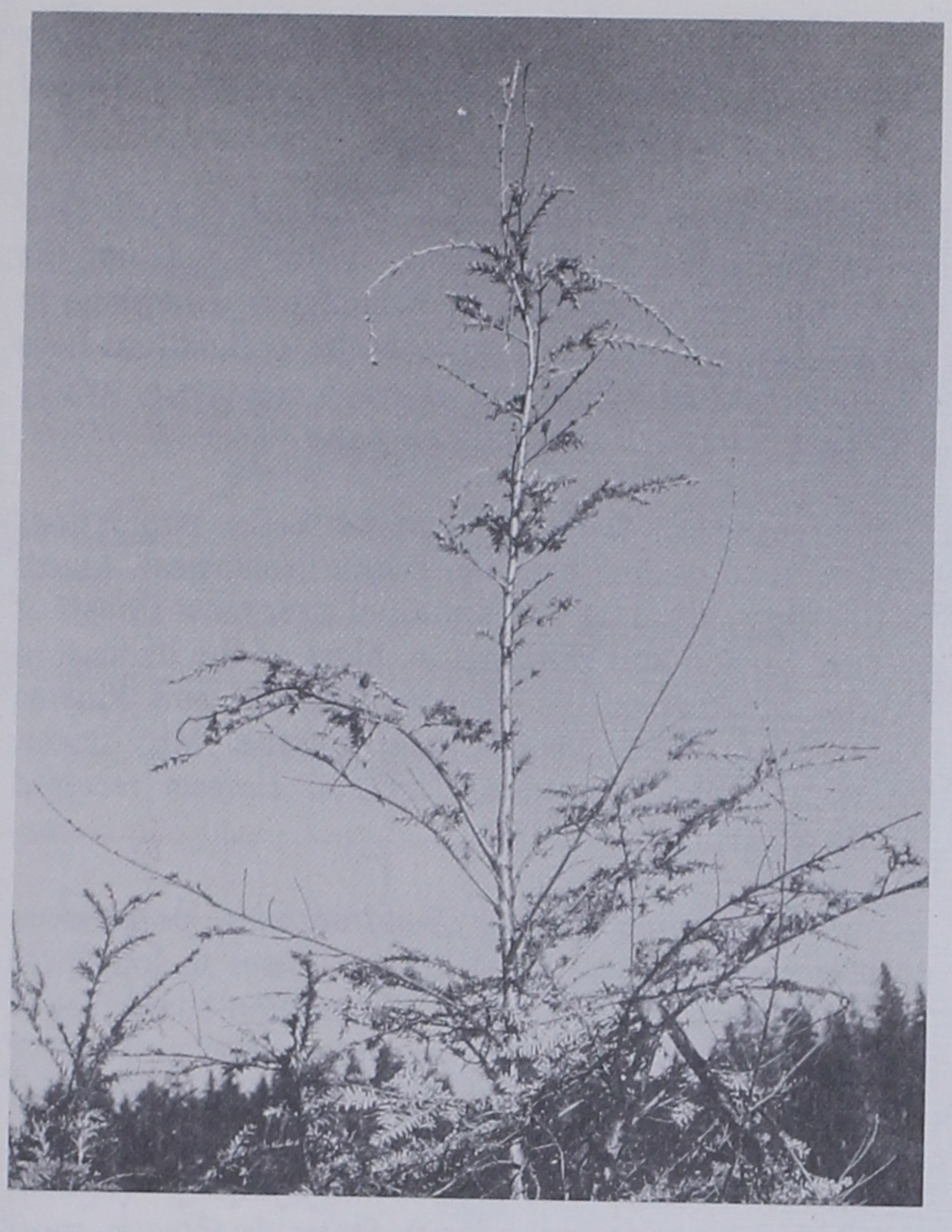

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Figure 3.—*Sirococcus* **shoot blight on western hemlock regeneration.**

and the crowns of overstory trees were showing the effects of cankering. Cankers with ascocarps were common on the dying understory trees. The fungus causes a perennial canker on coniferous hosts, infections occurring mainly through insect-feeding punctures and egg slits. *C. pseudotsugae* is found on hemlock growing on almost all sites within the coastal wet belt and normally causes little damage.

Spruce needle rust, *Chrysomyxa ledicola* (Pk.) Lagerh. Sitka spruce in the Mendenhall Valley near Juneau was again hit by needle rust. The discoloration of foliage was severe enough to arouse local interest but was still much less prevalent than in the previous year. Small scattered infected trees were noted in the vicinity of Petersburg and Ketchikan but little damage resulted.

Undetermined hemlock mortality. An unidentified disease caused some mortality in western hemlock at Edna Bay on Kosciusko Island. In stands which were partially harvested in the 1940's, scattered hemlock of all age classes show crown deterioration and mortality progressing from the lower branches toward the top. Most mortality was in the younger age classes.

Decay. The southeast Alaska cull study, a joint project of Region 10 and the Forestry Sciences Laboratory is about completed. Final data analyses have been made and results are being summarized. The study was designed to update existing cull factors prepared in 1956 and to improve tree volume estimates.

Frost damage. By early June, reports were received of foliage damage to paper birch in the Susitna River Valley on the southwest side of the Talkeetna Mountains. An aerial survey revealed 33,000 acres of what appeared as medium to heavy defoliation in the vicinity of Big Lake, Houston, and Willow. Damage is attributed to a premature bud break that occurred in the area, followed by spring frost along the base of the Talkeetna Mountains. The damage was noticeable to resident and nonresident recreationists that use the valley. All but a few "hot spots" had foliated by late July.

Winter drying. A 30-mile-long belt of winter drying was evident in spruce stands near the timberline on the north slope of the White Mountains near Mount Schwatka. The conspicuous foliage browning occurred on trees stressed by altitude as well as latitude. The growing sites are underladen with permafrost and have maximum exposure to northerly winds coming across the Yukon Flats from the Brooks Range.

Air pollution. Tree mortality in the vicinity of the pulpmill at Sitka is continuing. Chronic exposure to toxic sulphur emissions is associated with mortality of Sitka spruce, western hemlock, and Alaska cedar over approximately 400 acres.

An analysis was made of foliar samples collected near the pulpmill and of background samples collected 12 miles away at Old Sitka. Tree necrosis is known to occur at about 0.15 percent (by weight) sulphur level. Results of the analysis gave a sulphur content of 0.24-0.29 percent for Sitka spruce near the mill and 0.04 percent for the background sample. Comparable values for western hemlock were 0.31-0.39 percent versus 0.07 percent and for Alaska cedar 0.23-0.26 percent versus 0.04 percent. The sulfate content was 0.72-0.87 percent for Sitka spruce near the mill versus 0.12 percent for the background sample, western hemlock 0.93-1.17 percent versus 0.21 percent, and Alaska cedar 0.69-0.78 percent versus 0.12 percent.

Larch discoloration. A preliminary aerial reconnaissance of Bureau of Land Management land in interior Alaska revealed widespread yellowing of eastern larch approximately 140 miles southwest of Fairbanks. At the end of July, a dense distribution of individual trees appeared uniformly yellow in contrast with normal summer foliage of other larch. Some previous larch mortality was evident from the air. Normal autumn needle drop occurred before an on-the-ground examination could be arranged. A more thorough examination is

planned for 1974. Larch is scattered in muskegs and various moist soils in open stands with paper birch, black spruce, alder, and willow. The condition occurred intermittently over a 500-square-mile area extending from the confluence of the Herron and Foraker Rivers on the west across the McKinley River to Moose Creek, a tributary of the Kantishna River. Discolored crowns were observed farther north on the Kantishna River to a point 15 miles south of the abandoned village of Toklat.

OREGON AND WASHINGTON (R-6)

by

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Conditions in Brief

Defoliators were the most destructive insects in the Pacific Northwest forests during 1973. The Douglas fir tussock moth alone caused havoc on 689,760 acres of Douglas-fir and true fir in Oregon and Washington. The western spruce budworm has also been an important defoliator this past year. In Washington and Oregon, the budworm caused visible defoliation on 330,340 acres of Douglas-fir and true fir. Isolated populations of the black-headed budworm continue to cause minor defoliation of western hemlock in Washington.

Bark beetles remained active in the Pacific Northwest forests in 1973. The mountain pine beetle continued to cause heavy losses in lodgepole pine stands of eastern Oregon and in western white pine stands in the Cascade Mountains of both States. The western pine beetle losses in ponderosa pine stands in Oregon increased but there was a general decline in the Douglas fir bark beetle activity. Losses were light and scattered over both Oregon and Washington.

Root diseases were prevalent throughout the Northwest in 1973. Root rots caused serious losses to timber stands while damping-off fungi caused significant losses in forest nurseries. Needle casts of Scotch pine affected Christmas tree plantations in Oregon and Washington. The Dutch elm disease has been detected for the first time in Oregon.

Status of Insects

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. These insects killed approximately 7,136,000 board feet of Douglas-fir over Oregon and Washington in 1973. Losses this past year were only about one-third of those which occurred the previous year. Most of the damage was centered in the Columbia River Gorge of both Oregon and Washington. Losses are expected to decline for at least another year.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Tree killing continued in Engelmann spruce stands on the Okanogan National Forest in Washington. Elsewhere in Oregon and Washington, spruce beetle populations have declined. Aerial detection surveys reported widely scattered patches of mortality.

Fir engraver, *Scolytus ventralis* LeC., populations continued to decline over the Pacific Northwest. Losses in true firs were light and scattered over most forests of eastern Oregon and Washington. Most of the damage in Oregon occurred on the Ochoco, Umatilla, and Winema National Forests. In Washington, the Mt. Baker, Okanogan, and Wenatchee National Forests received significant damage.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., continued to cause serious losses in lodgepole pine stands of Oregon. Nearly 35.5 million board feet of timber was killed this past year. More than one-half of this loss occurred on the Wallowa-Whitman National Forest. In Washington, losses continued to be light. Losses of western white pine continue high throughout the mountainous regions of both States. In Oregon, most white pine losses occurred in the Willamette National Forest. Losses in Washington were heaviest on the Snoqualmie and Wenatchee National Forests. Mountain pine beetle attacks in pole-sized ponderosa pine increased slightly in both Oregon and Washington.

Western pine beetle, *Dendroctonus brevicomis* LeC., infestations increased in several mature and overmature ponderosa pine stands in Oregon. Most of the losses occurred in central Oregon where over 4 million board feet of ponderosa pine was killed on the Deschutes and Ochoco National Forests. In Washington, the loss was light and tree killing was widely scattered.

Douglas fir tussock moth, *Orgyia pseudotsugata* McD. Outbreaks of this defoliator continued to infest new acreage. In Oregon and Washington during 1973, light to heavy defoliation occurred on 672,490 acres as compared to 196,810 acres in 1972. In addition to the acreage classified as defoliated only, another 17,270 acres were classified as dead in 1973.

Most of the devastation occured in the Blue Mountains of northeast Oregon and southeast Washington where 629,500 acres were either defoliated or killed. On the Colville Indian Reservation in Washington, 36,170 acres received light to heavy defoliation. Defoliation also occurred on 23,450 acres of State and private lands in northeast and central Washington. A total of 160 acres were damaged on the Colville National Forest and 480 acres on the Wenatchee National Forest were defoliated.

DISTRIBUTION OF DOUGLAS FIR TUSSOCK MOTH OUTBREAK IN THE BLUE MOUNTAIN AREAS IN OREGON AND WASHINGTON

LEGEND

VISIBLE DEFOLIATION 1972

VISIBLE DEFOLIATION 1973

F-522797

Figure 4.–Distribution of Douglas fir tussock moth outbreak in the Blue Mountain areas in Oregon and Washington.

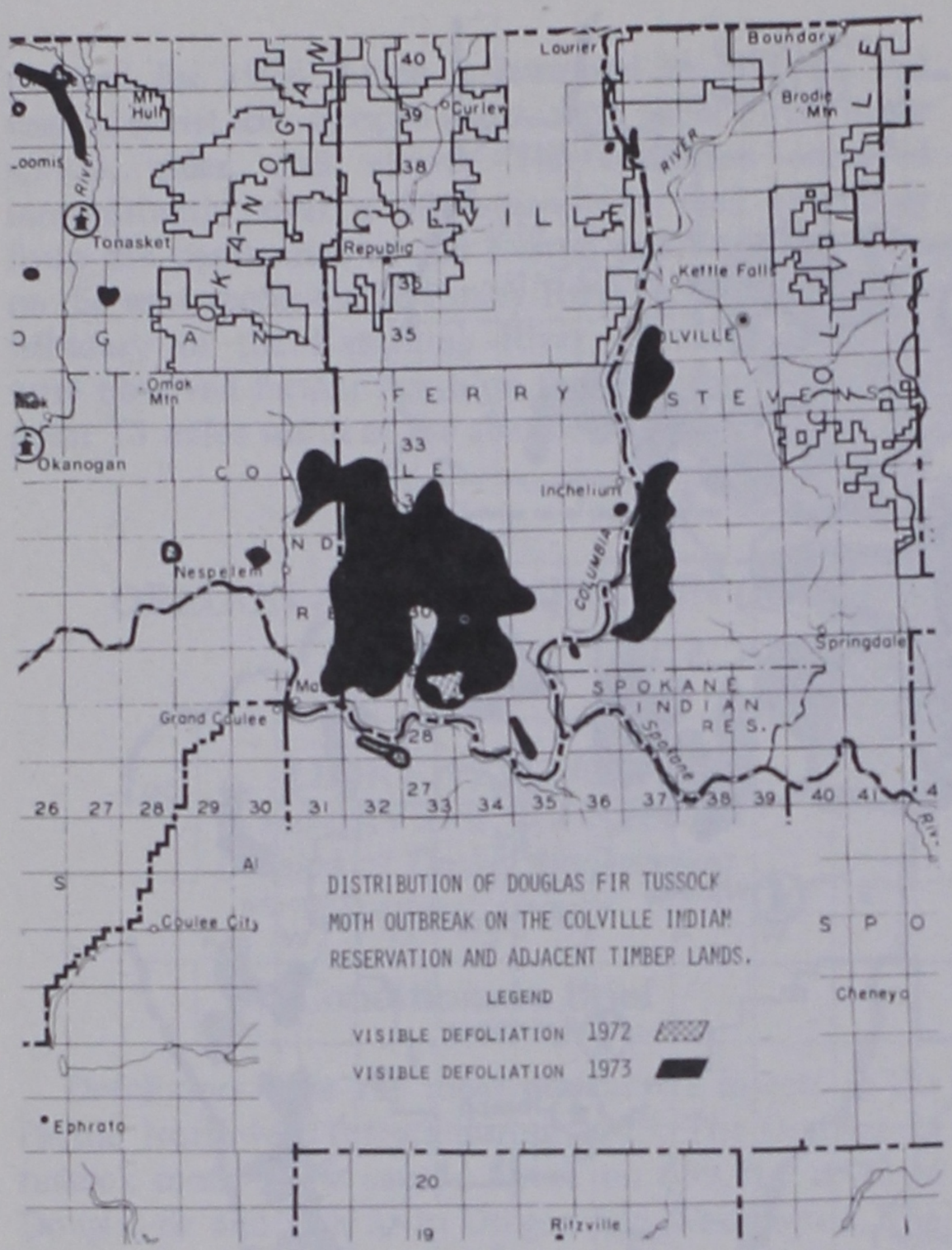

Figure 5.–Distribution of Douglas fir tussock moth outbreak on the Colville Indian Reservation and adjacent timberlands.

Biological evaluations and surveys will not be completed until late winter; however, early findings indicate there are areas where the tussock moth will continue to defoliate and kill trees in 1974 (figs. 4 and 5).

Defoliator monitoring plots showed that the high populations of tussock moth larvae common over eastern Oregon and Washington last year are not occurring this year. The Klamath Ranger District, Winema National Forest, was the only area outside the general zones of infestation to show higher than normal populations.

A request to use DDT to control expected serious infestations was filed with the Federal Environmental Protection Agency, but the request was denied. There were no other proven chemicals available for operational control.

In trying to find an effective replacement for DDT, four insecticides, Zectran, Dylox, Sevin 4-Oil, and Bioethanomethrin were tested against the Douglas fir tussock moth on 400- to 500-acre plots. When the request for emergency use of DDT was denied, the Zectran test was expanded considerably, mostly on private lands in Oregon and on the Walla Walla watershed in Washington. About 70,000 acres were treated during June and early July 1973 with a double application of Zectran (fig. 6).

Results of the insecticide tests in Oregon and Washington show that all the chemicals killed considerable numbers of tussock moth larvae, but none reduced the population sufficiently to prevent severe defoliation and tree mortality.

The Pacific Northwest Forest and Range Experiment Station tested formulations of two microbial agents, a nuclear polyhedrosis virus and the bacterium *Bacillus thuringiensis*. The treatments were applied by helicopter to several 20-acre plots. Results of these tests indicated both microbials held good potential as a control for the tussock moth.

Western spruce budworm, *Choristoneura occidentalis* Free. Infestations of the western spruce budworm continued to increase throughout Oregon and Washington. In Washington, an increase in defoliated acres was evident while, at the same time, there was a decrease in the intensity of defoliation. Top-killing or tree mortality due to defoliation has not been observed. If the current level of defoliation continues, it is estimated that these stands can sustain 2 or 3 more years of feeding before significant top-killing will occur. Defoliation which is visible from the air has occurred on 282,130 acres on the Wenatchee and Okanogan National Forests, and the North Cascades National Park. In Oregon, defoliation has been limited to the Wallowa-Whitman National Forest in northeast Oregon. The current level of defoliation has not resulted in serious tree damage. Fall egg surveys, although not complete, indicate infestations will continue in all areas into 1974.

Defoliator monitoring plots, examined in late June, revealed higher than normal populations over most of eastern Oregon and Washington. Most noticeably high populations, outside of the defoliated areas, were over the entire east slopes of the Cascade Mountains in Washington, and the Burns and Prairie City Ranger Districts of the Malheur National Forest in Oregon.

Modoc budworm, *Choristoneura virdis* Free. Populations of this insect increased in white fir stands in the Warner Mountains on the Fremont National Forest. Light defoliation was observed on 20,840 acres. This outbreak is not expected to cause any serious problems next year.

Western black-headed budworm, *Acleris gloverana* Wlshm., populations continued to cause light defoliation of western hemlock at widely scattered localities in western Washington. Visible defoliation occurred on the Olympic and Mt. Baker National Forests and the Olympic National Park. The defoliation is not causing serious tree damage at the present time.

Balsam woolly aphid, *Adelges piceae* (Ratz.) infestations continued to cause damage in true fir stands of western Oregon and Washington. Most outbreaks occurred on the Willamette, Mt. Hood, and Deschutes

F-522799

Figure 6.–Zectran being applied by helicopter to Douglas fir tussock moth-infested forest near La Grande, Oreg.

National Forests in Oregon and the Gifford Pinchot and Snoqualmie National Forest in Washington.

Larch casebearer, *Coleophora laricella* Hbn., continued to spread in western larch stands throughout eastern Washington and northeast Oregon. The insect has not been found in the Cascade Mountains of Oregon and Washington or in the Ochoco Mountains of central Oregon. In the continuing attempts to establish a biological control, three species of parasites have now been introduced. *Agathis pumila* (Ratz.) has been released at many localities throughout the infestation. *Dicladocerus westwoodii* West. has been released in southeast Washington and northeast Oregon. *Chrysocharis laricinellae* (Ratz.) has been released on the Colville Indian Reservation in northeast Washington.

Other insects. Pine engraver, *Ips pini* (Say), killing young ponderosa pine remained at a low level with most of the damage occurring in Oregon. The silver fir beetles, *Pseudohylesinus* spp. caused some tree killing of Pacific silver fir in northwest Washington. The larch sawfly, *Pristiphora erichsonii* (Wong and Ross), caused visible defoliation on 1,200 acres of western larch on the Warm Springs Indian Reservation in Oregon. Other sawflies, *Neodiprion* spp., caused light defoliation of knobcone pine in southwest Oregon.

Status of Diseases

Rhizina root rot, *Rhizina undulata* Fr. This root disease has been reported to be killing conifer seedlings planted on recently burned clearcuts. In 1973, 278

recently burned clearcuts covering more than 12,500 acres were examined by the Washington State Department of Natural Resources, Oregon State Department of Forestry, and the U.S. Forest Service for the presence of *Rhizina undulata*. Rhizina ascocarps were detected on 65 of the clearcuts. Less than 0.5 percent of the trees on units where Rhizina ascocarps were found were killed by the root rot. This disease is not considered to be of regional importance in Oregon and Washington at this time.

Port-Orford-cedar root rot, *Phytophthora lateralis* Tucker and J. Milb. From the time the fungus was introduced into the Pacific Northwest in the 1920's until the present, it has virtually destroyed most Port-Orford-cedar ornamentals and nurseries in western Washington and the Willamette Valley of Oregon. In 1952, it was detected in the native stands near Coos Bay, Oregon. Several million board feet of timber has been killed by the disease.

A tentative program for protecting the remaining Port-Orford-cedar stands has been developed by Dr. Roth of Oregon State University. The program calls for identifying cedar production sites, creation of protection areas, dry season harvesting, regulation of mechanical travel, the use of clean equipment, and helicopters for logging. With present Port-Orford-cedar selling for as much as $1,400 million board feet, there is widespread interest in implementing the proposal.

Annosus root rot, *Fomes annosus* (Fr.) Karst. Eastern Oregon and Washington—Annosus root rot was identified as the cause of substantial but not serious mortality in two ponderosa pine plantations on the Fremont National Forest. In both plantations, the root rot spread from large stumps created during commercial sale operations. Small stumps created by precommercial thinnings did not serve as infection courts.

Annosus root rot is found infrequently in east side conditions in spite of many years of thinning and partial cutting. It is not considered to be a serious problem at this time.

A report prepared by the Washington State Department of Natural Resources and the University of Washington listed the following conclusions:[1]

1. Stump infection by *Fomes annosus* occurs in eastern Washington but the infection was low, rarely infecting more than 15 percent of the stumps sampled.
2. Moisture availability appeared as the strongest factor related to frequency of infection. The more annual rainfall the greater the frequency of infection.
3. Temperature, both maximum and minimum as recorded in the survey, did not appear to influence frequency of infection.
4. Severe winters reduced infection levels.
5. Ponderosa pine stumps may be susceptible to infection for periods as long as 3 to 4 months.

Armillaria root rot, *Armillaria mellea* Vahl. ex. Fr. Armillaria root rot is a common root disease problem in the forests of Oregon and Washington. Ordinarily the fungus attacks trees which are under stress. Mortality is usually confined to only a small number of trees. Occasionally *A. mellea* becomes very pathogenic, killing large numbers of trees on a large area. At least three such intensive disease sites have been located in Oregon and Washington. Infection sites detected on the Winema and Fremont National Forests cover more than 1,000 acres. A similar disease site has been detected near Glenwood, Wash., on lands owned by the St. Regis Paper Company. Species killed on the Winema National Forest site included ponderosa pine, lodgepole pine, western white pine, incense cedar, and white fir.

At the Glenwood site, Oregon State University is conducting research studies on rate of spread and control measures.

Winter drying. The winter of 1972-1973 caused the most severe winter damage since 1955. Below average snowfall accompanied by cold temperatures and drying wind during December and January produced spectacular damage on thousands of acres in the Pacific Northwest.

Damage was most evident in the Puget Sound and Columbia River lowlands and madrone stands in southwestern Oregon. Injury was observed on Douglas-fir, western hemlock, ceanothus, madrone, ornamental pines, and other offsite species. Exposed trees were most severely injured but many recovered during the 1973 growing season. Some Douglas-fir and madrone on exposed sites were killed.

A related form of damage was observed on many high elevation sites. The tops of small trees not fully covered by snow were killed in several plantations. Approximately 15 to 20 percent of the Douglas-fir in a plantation on the Gifford Pinchot National Forest suffered top-kill. Similar losses were observed in other stands in Washington.

Needle casts of Scotch pine, *Lophodermium* spp. As many as four different species of Lophodermium have been found on the foliage of Scotch pine being raised for Christmas trees in Washington and Oregon. If not controlled, these fungi render the trees unmerchantable.

Fungicide trials conducted in 1972 and 1973 revealed that Dithane M-45 applied five times from June to September, at the rate of 2 pounds total material per 100 gallons of water with 4 ounces of spreader-sticker, provided the most protection from the needle casts.

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[1] K. W. Russell, R. E. Wood, and C. H. Driver. 1973. *Fomes annosus* Survey in eastern Washington. Unpublished report presented at the Fourth International Conference on *Fomes annosus* held at Athens, Ga., Sept. 1973. 17 p.

Only 5 percent of the foliage treated at this rate was infected.

Nursery diseases. Several beds of Douglas-fir seedlings in the Wind River Nursery, Carson, Wash., suffered losses from damping-off fungi. Most of the losses occurred before an application of Dexon was made.

Diseases of tree seedlings grown in containers under greenhouse conditions are becoming more important. Conditions are ideal for the rapid buildup of pathogenic organisms such as *Pythium, Fusarium,* and *Botrytis* spp. It is extremely difficult to raise a successful crop without periodic applications of fungicides. Approximately 10 million container-grown seedlings were produced in Oregon and Washington in 1973.

The effectiveness of seven fungicidal seed treatments for preventing seed and seedling losses was tested in 1973. Materials tested included:

Arasan 42-S
Arasan 75
Benlate WP
Captan 75
Dexon 35 WP
Chemagro CHE 1843-Preseed

Dexon 35 WP applied at the rate of 2 ounces active ingredient per 100 pounds of seed provided the best protection for ponderosa pine seeds. Arasan 75 applied at the rate of 35 ounces active ingredient per 100 pounds of seed provided the best protection for Douglas-fir seeds.

The seed treatments were more effective in reducing damping-off losses caused by *Pythium* spp. The treatments were less effective in preventing root rot losses caused by *Fusarium* spp. Fusarium root rot appeared approximately 3 weeks sfter the seeds were sown. Additional field tests of Dexon 35 WP are planned.

Western gall rust, *Endocronartium harknessii* (J. P. Moore) Y. Hiratsuka. The rust has intensified on shore pine, *Pinus contorta,* on the Dunes National Recreation Area on the Oregon coast within the last 5 years. Many small branches have been killed as a result of the galls. Trees established from local seed sources appear to possess a greater degree of resistance than those developing from nonlocal sources. A program is underway to collect seeds from resistant local seed sources. These seeds will be used to reforest portions of the area.

Unidentified canker of douglas-fir. An unidentified canker was observed on approximately 32 percent of the Douglas-firs examined in two 10- to 15-year-old plantations on the Mt. Baker National Forest in Washington. The canker has been observed in at least four other plantations.

The large sunken reddish cankers originate from galleries of *Laspeyresia* spp. cambium miners. Many cankered trees have also suffered from snow breakage.

Attempts to isolate and identify the casual organisms are continuing. Semipermanent plots have been established in infected stands to follow the progress of the disease.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. Dutch elm disease has been detected in American elms in the communities of Ontario and Nyssa, Oreg.

Douglas fir bacterial gall, *Bacterium pseudotsugae* Hansen and R. Smith. Galls caused by *Bacterium pseudotsugae* were detected on a small number of Douglas-fir seedlings in the Wind River Nursery. Approximately 50 percent of the suppressed trees on 200 acres in a stand on the Rogue River National Forest had galls.

CALIFORNIA AND HAWAII (R-5)

by
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Conditions in Brief

Large changes in forest pest activity were noticeable in 1973. An outbreak of budworms on the Modoc National Forest was the largest defoliator epidemic ever recorded in California. White fir sawflies severely defoliated several smaller areas in the northern part of the Region. Various bark beetle outbreaks contributed to serious losses in both recreation and commercial forests. The most encouraging trend in forest insect pest activity in 1973 was the continuing decline of defoliation by the Douglas fir tussock moth. The spread of the Eurasian pine aphid remains an important problem in Hawaii.

Verticicladiella wagenerii was found infecting Douglas-fir in a new center on the north coast near Big Lagoon. At Sugar Pine Creek on the Eldorado National Forest, *V. wagenerii* was found on sugar pine, ponderosa pine, and Douglas-fir in the same center, a situation previously undetected. Road deicing salts caused extensive damage to trees in the Lake Tahoe Basin, and there were reports of similar damage at Mammoth Lakes in the Inyo National Forest. Winter temperatures fell to record lows throughout California in 1972-73, causing extensive frost damage to conifers and hardwoods. In Hawaii,

[2] Reporting on conditions in California.
[3] Reporting on conditions in Hawaii.

work continues to determine cause and means of controlling the Koa and Ohia declines.

Status of Insects—California

Budworms, *Choristoneura* spp. Light to moderate defoliation of true fir and lodgepole pine exists throughout 148,000 acres on the Modoc National Forest. The epidemic encompasses almost all of the Warner Mountain range and a smaller area at Knox Mountain. Insect specimens from the infestation have been identified as *C. lambertiana* (Busck), and *C. viridis* Free. The Forest Service mapped the area by helicopter and ground surveys, and established 13 population sampling plots. Laboratory work to evaluate the samples is in progress.

A budworm infestation in lodgepole pine was also detected at Sentinel Meadows on the Inyo National Forest.

Douglas fir tussock moth, *Orgyia (Hemerocampa) pseudotsugata* McD. Aerial and ground detection confirmed a continuing decline in Douglas fir tussock moth activity. Only two active centers of infestation could be found: at Skull Creek and at Jawbone Pass on the Stanislaus National Forest, infesting about 200 acres and 30 acres of white fir trees, respectively. The Skull Creek infestation collapsed and dead timber has been salvaged from the site. The Jawbone area was destroyed by the Granite fire.

General observations of the rise and decline of the Douglas fir tussock moth between 1970 and 1973 suggest that the virus disease of the moth did not play an important role in ending the epidemic. The reason for the population collapse has not been determined.

Lodgepole pine needle miner, *Coleotechnites milleri* (Busck). High mortality of overwintering larvae, resulting from the unusually cold period during the winter, reduced the needle miner infestation in Yosemite Park. Consequently, heavily used recreation sites continue to escape serious damage. Nevertheless, the chronic outbreak remains viable and defoliation continues in more remote areas of the park.

White fir sawfly, *Neodiprion abietis* (Harris). While the area of white fir sawfly defoliation declined since 1972, several locations sustained serious damage. These include large spots east of Jackson Lake and south of Sierra City on the Tahoe National Forest, and near Buck's Lake and Blue Nose on the Plumas National Forest.

In the Jackson Lake area, *Dichelonyx* sp. beetles feeding on young foliage substantially increased the injury to sawfly-infested trees.

Gypsy moth, *Porthetria dispar* (L.). Detection of egg masses in northern California has caused great concern. The transportation of viable egg masses on recreational vehicles and household items from the Eastern United States presents a difficult quarantine problem for California. Detection efforts by the State have been greatly increased.

Douglas fir beetle, *Dendroctonus pseudotsugae* Hopk. The Douglas fir beetle continued to increase tree killing on the Plumas National Forest. More than 40 localized outbreaks, containing perhaps 3,000,000 board feet of dead and dying Douglas-fir trees, have been identified by aerial and ground surveys. Efforts to control the losses and to salvage infested trees have been thwarted by the steep, inaccessible terrain. So far, large-capacity helicopters have been unavailable to begin the salvage job.

Western pine beetle, *Dendroctonus brevicomis* LeC. Killing of ponderosa pine by western pine beetles declined about 50 percent at McCloud Flats in Siskiyou County. The decline followed the destruction of 75 percent of the overwintering beetles by unusually cold weather and by improved timber management through thinning sales. The Forest Service ceased dispensing beetle attractants for the McCloud Flats Pheromone Study, but continued to monitor beetle populations and tree mortality.

Elsewhere in California the beetles continued to kill ponderosa pines at a normal level. Notable locations of activity were the following: French Creek in Siskiyou County; Soldier Mountain, Lassen National Forest; Barnes Mountain, Sierra National Forest; and the continuing epidemic around the Red Mountain Burn in the Sequoia National Forest. Suppression by logging was conducted in most of these areas.

In southern California, western pine beetles continued to be the major killers of ponderosa and Coulter pines, particularly in the Lake Arrowhead area of the San Bernardino National Forest. Maintenance control continues in several southern California forests.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain pine beetle population suffered severe cold-induced mortality in some areas during the winter of 1972-73. Spot surveys revealed a winter brood-kill of about 90 percent at Lake Tahoe and at Wrights Lake, with a subsequent reduction of about 80 percent in tree killing during 1973. Nevertheless, the beetles continue to be important killers of lodgepole pine at Wrights Lake and at South Lake Tahoe in El Dorado County.

At June Mountain and Sherwin Bowl in the Inyo National Forest, mountain pine beetle epidemics developed in high-elevation stands of lodgepole, western white, and whitebark pine. The beetles continue to kill large sugar pine elsewhere, most notably in northern Butte and in eastern Tehama Counties. Some local direct control efforts are proposed in important recreation sites.

The fir flatheaded borer, *M. drummondi* Kby., killed (1) a large group of Douglas-fir trees near Junction City in Trinity County; (2) a smaller number at Gasquet in Humboldt County; and (3) scattered true firs on the Eldorado National Forest.

Primary flatheaded bore s, *Melanophila* spp. The California flatheaded borer, *M. californica* Van Dyke, killed thousands of Jeffrey pines in the Laguna Mountains of the Cleveland National Forest. The beetle also attacked many Jeffrey pines in the Garner Valley, San Bernardino National Forest, and at Piute Peak, Sequoia National Forest.

Salvage logging and maintenance control were conducted in the Laguna Mountains and at Garner Valley; salvage logging is proposed at Piute Peak.

Pine engraver beetles, *Ips paraconfusus* Lanier, and *I. pini* (Say). Depredations in young pine stands throughout the State were the severest in many years. The worst problem has developed in the Garner Valley of the San Bernardino National Forest, but significant infestations have been reported from Yucaipa Ridge on the San Bernardino National Forest; Mosquito Road on the Eldorado National Forest; Dago Springs and Jelly Camp on the Lassen National Forest; Lake Britton and Willow Creek on the Shasta-Trinity National Forest; and Fish Meadows and Deer Mountain on the Klamath National Forest. Scattered groups of killed trees were reported in northern Butte and eastern Tehama Counties, and in the Fort Jones and Scott Valley areas of Siskiyou County. In several locations, the western pine beetle has been found in association with the pine engraver beetle on young ponderosa pine trees. In most cases suppression was not recommended.

Spots of knobcone pine mortality have been reported from several areas. Most of this damage is probably due to ips activity.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. The only serious infestation of this beetle reported in 1973 developed in fire-damaged timber at Breckenridge, on the Sequoia National Forest.

Other beetles. Activity by the fir engraver beetle, *Scolytus ventralis* LeC., on white fir subsided to endemic levels. Some damage by a twig beetle, *Pityophthorus* sp., was reported on lodgepole pine. The round-headed fir borer, *Tetropium abietis* Fall, was suspected of killing firs in parts of the Eldorado National Forest.

Black pine leaf scale, *Nuculaspis californica* (Coleman). The wide-spread infestation of black pine leaf scale on sugar pine, reported in recent years in northern California, has declined to near-endemic levels. Unusually cold winter temperatures may have adversely affected the overwintering scale populations. Near Bass Lake, on the Sierra National Forest, a scale infestation persists in a roadside environment, seemingly encouraged by the application of road oil.

Other insects. Grasshoppers devastated recently established pine plantations at Iron Mountain, Yellow Jacket and Cub Hill in the Shasta-Trinity National Forest. At Iron Mountain the pest was identified as *Oedaleonotus enigma* (Scudder). Forest Service breeding-orchard plantings at Badger Hill on the Eldorado National Forest were protected from grasshopper damage with insecticides. The Shasta-Trinity infestations may require spraying in 1974. The infestations of the imported Nantucket pine tip moth, *Rhyacionia frustrana* Comstock–reported in 1972 as the western tip moth, *R. bushnelli* (Busck)–continue unabated in southern California, primarily on Monterey pine. Four generations of the aggressive pest were reported in 1973. A delineation survey and some form of containment or quarantine are needed to deal with this potentially destructive insect. Cursory spot checking indicates that the Eucosma shoot moth, *E. sonomana* Keaf., is present throughout the eastside Jeffrey and ponderosa pine plantations north of Interstate 80. The reproduction weevil, *Cylindrocopturus eatoni* Buch., damaged pine plantations again in 1973, most conspicuously near Snow Tent Springs on the Tahoe National Forest, Coon Rod Flats and Seven Mile Pit on the Shasta-Trinity National Forest, and Mallum Ridge on the Sierra National Forest. The pine needle sheath miner, *Zelleria haimbachi* Busck, was also active in scattered localities.

Status of Insects–Hawaii

Eurasian pine aphid, *Pineus pini* Koch, continues to ravage some of the pine species found in the island of Maui. The State Department of Agriculture has not been too successful in controlling aphids on backyard ornamentals. Infestations continue to be discovered in the forest lands where conifers are planted. In June and July heavily infested trees were found in the Waihou Springs Forest Reserve. Recognizing the value of experimental pine stands in the area and other locales Statewide, the Division of Forestry has conducted a series of public meetings, and developed an Environmental Impact Statement to publicize its plans to treat infected areas with Diazinon with aerial spraying. As of this writing, no action to this end has been taken, pending comments and recommendations from public groups and the Office of Environmental Quality Control. Biological control is being considered, but needs to be investigated further. Chemical treatment is essential now to diminish and control the pine aphid problem; additional effort to establish and maintain built-in biological controls are recognized and supported.

Acacia psyllid, *Psylla uncatoides* (Ferris & Klyver). All islands reported a reduction in the number of

psyllids observed. Although damage to koa and koaia was negligible this year, the potential for major outbreaks of the insect persists with seasonal changes. Several releases of the coccinellid beetles, *Diomus* sp., have been released to combat *Psylla uncatoides* on the island of Hawaii by the State Department of Agriculture. Preliminary observations of this biological agent have been promising, but need to be studied further to determine its ability to establish itself as an effective and self-sustaining psyllid predator. *Humonia conformis,* a lady beetle, is also being studied in its predation against the psyllid.

Black twig borer, *Xylosandrus compactus* (Eichhoff). This beetle continues in great proportions throughout the State. Host species of plants include both native and exotic plant species ranging in size from shrubs to trees. *Xylosandrus compactus* has been found most notably on host species in some stage of dieback. However, to determine the amount of damage attributable to this insect, it is necessary to conduct surveys on a monthly basis. The seasonal activity and population of spread also remain to be studied.

Carolina coniferous aphid, *Cinara carolina* Tissot. This aphid has been reported on the islands of Maui and Molokai this year. The heaviest infestations were commonly found on pine trees about 15 to 20 feet tall. Light infestations were recorded on 5- to 8-foot pines, and 30- to 50-foot trees in the Polipoli, Maui area. Damage appears to be negligible even though prolonged attacks occurred.

Monkeypod-kiawe caterpillar, *Melipotis indomita* (Walker). Light trap collections on Oahu showed a buildup in the insect's population during the period March-May. Despite population buildup, however, it did not peak to infestation levels as in previous years. Damage to host trees was less severe as evidenced by improved tree conditions, greater foliar and terminal recovery. Early in February, the State Department of Agriculture announced the laboratory emergence of a parasite which preys on *Melipotis indomita.* This wasp has its origin in Bolivia where it was discovered by William Rose, Department of Agriculture's exploratory entomologist. The wasp shows favorable promise as a biocontrol agent.

Status of Diseases–California

Black staining root disease, *Verticicladiella wagenerii* Kendrick (fig. 7). Several new infection centers were found in Douglas-fir forests on the north coast near Big Lagoon, Humboldt County. Previously, the disease was discovered infecting Douglas-fir on the Jackson State Forest, and infecting sugar pine, western white pine, and knobcone pine on the Six Rivers National Forest northeast of Gasquet.

F-522800

Figure 7.–A cross section of singleleaf pinyon pine infected with *Verticicladiella wagenerii* shows how the black stain occurs in arcs that parallel the annual rings.

For the first time in California, *V. wagenerii* was found killing sugar pine, ponderosa pine, and Douglas-fir within the same infection center. In all previous reports the fungus killed pines and Douglas-fir in separate centers, even within mixed-conifer stands. This new infection center, approximately 20 acres in size, was found in Sugar Pine Creek on the Eldorado National Forest.

Annosus root rot, *Fomes annosus* (Fr.) Cke., continues to be a problem in certain areas of the eastside pine type. Data gathered by the University of California indicates that it may also be a major killer and butt rot in the true firs of the Sierra Nevada. Preliminary evidence suggests that this is not a new problem, but a chronic condition that is being studied now for the first time.

Nursery diseases. At the Forest Service nursery near Placerville in El Dorado County, *Botrytis cinerea* (Fr.) Pers., killed many Monterey knobcone pine seedlings, and also the tips of ponderosa pine seedlings in storage.

At the Forest Service nursery in McKinleyville, in Humboldt County, some minor damage was caused by *Roselinea herpotrichoides* Hept. & Dav., on 2-0 Douglas-fir; *Pythium* spp. killing containerized Douglas-fir; *Phomopsis lokoyae* Hahn killing containerized Douglas-fir; *Botrytis cinerea* on coast redwood; and

Sirococcus strobilinus (Desm.) Petr., on ponderosa and Jeffrey pine.

Extensive frost damage on Douglas-fir was reported from the California Division of Forestry nursery near Magalia, Butte County.

Abiotic damage. Frost damage to conifers and hardwoods was reported from throughout the State following an exceptionally cold winter.

Damage from severe freezing temperatures was most conspicuous to exotic species. Plantings of Australian blue gum trees were particularly hard hit throughout much of California. Potentially disastrous fire conditions developed from the accumulation of dead foliage, branches, and trees in densely populated Oakland and Berkeley Hills, resulting in a declaration by the President of major disaster situation. To mitigate the fire hazard, over 20 miles of 300-foot-wide fuelbreak was constructed with Federal funds.

Road deicing salts. Road deicing salts caused extensive damage in the Lake Tahoe Basin. A survey conducted by the Forest Service and by Pacific Southwest Forest and Range Experiment Station located more than 200 sites along the major highways within the basin where damage attributable to deicing salts was evident. The size of the areas ranged from a single tree center to an area 0.3 miles long in which many trees were killed or damaged. Additional reports of salt damage were received from the Mammoth Lakes area of the Inyo National Forest.

Status of Diseases–Hawaii

Koa and Ohia decline. Team effort continues to determine the cause, extent, and rate of spread of the koa and ohia decline, under the leadership of the Institute of Pacific Island Forestry. The current survey indicates that over 200,000 acres of native forest in the Hilo, Upper Waiakea, and Olaa Forest Reserves are plagued and threatened by the dieback to a varying degree. This information was ascertained by detailed aerial photo interpretations of photos of 1950-54, 1962-66, and 1972-73, and ground checks by research and survey foresters. The Bishop Museum, with the aid of a USDA Forest Service grant, is conducting entomological work on ohia borers. The University of Hawaii again with Federal assistance, has pathologists and entomologists studying the problem, to determine the cause and a remedy for the decline.

Needle cast fungus, *Lophodermium pinastri* (Schrad. ex. Fries) Chevallier. Observations of dying or dead Monterey and Cluster pine trees in the Molokai Forest Reserve (December 1972), prompted an investigation by a team of foresters, pathologists, and entomologists from the Division of Forestry, University of Hawaii, Department of Agriculture, and the Institute of Pacific Island Forestry, in January of 1973. *Lophodermium pinastri* was found in epidemic proportions in ground litter and tree foliage. Discussion of this problem yielded some interesting information about the fungus and suggested a number of treatments to remedy the situation.

Basically, the fungus is worldwide in occurrence and is endemic to pine in its native lands. Pines live with it, but under stress conditions, the trees become susceptible to attack by this fungus. In the Molokai situation, it is believed that drought over the past several years triggered the stress condition to permit the spread of the needle cast fungus; research is essential, however, to corroborate soil-moisture stress condition, with disease occurrence.

Chemical treatment and silvicultural practices were the alternatives to consider in combatting the fungus. The former, being aerial application of copper sulfate, was too costly to consider under local conditions, the latter being more desirable in the form of thinning. Since the inoculum was so abundant on the forest floor, prescribed burning was also recommended.

Evaluation plots need to be established to determine the extent and rate of spread. Most important of all, more research needs to be conducted to determine the factors that allowed the fungus to build up in epidemic proportions in order to protect other pine stands which are equally susceptible to the disease.

Koa rust, *Uromyces koae* Arth. The incidence of koa rust increased in the Hawaii Volcano National Park, particularly in the lower elevations. University of Hawaii pathologists have confirmed two species of *Uromyces* associated with Acacia koa: A canker type on the phyllodes and a "witches broom" rust on terminals, the latter being more prevalent at lower elevations. *Psylla uncatoides* remains suspect in the spread of *Uromyces* species.

INTERMOUNTAIN STATES (R-4)[4]

by
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Conditions in Brief

Bark beetles continue to be the most destructive group of forest pests in the Intermountain Region during 1973. The mountain pine beetle is the most damaging

[4] Includes forested lands in Utah, Nevada, southern Idaho, western Wyoming, and eastern California.

and continues its steady depletion of lodgepole and ponderosa pine throughout portions of southern Idaho, western Wyoming, and northern Utah. Although populations are apparently on the decline, serious tree killing continues with a few localized infestations showing increases. The anticipated increase in infestation intensity on the Moose Creek Plateau, Targhee National Forest, did not materialize; evaluation surveys indicate a decline, at least for 1974.

The 5-year standing spruce beetle outbreak on the Manti-LaSal National Forest, Utah, continues unabated. Continued high losses of merchantable volume can only be averted by an aggressive salvage program.

The once damaging Douglas fir beetle infestation in southern Idaho continues its downward trend, except on the Targhee National Forest where tree losses are increasing. *Ips* spp. and other secondary beetles continue to kill small diameter lodgepole pine in the aftermath of mountain pine beetle outbreaks.

The main defoliators are the western spruce budworm, pine butterfly, and Douglas fir tussock moth, but they are generally on the decline. Defoliation by the western spruce budworm in 1973 was less than half of that recorded in 1972, and evaluation survey data portend even less damage in 1974. Pine butterfly populations are decreasing on the Payette National Forest but increasing on the Boise National Forest, Idaho. Defoliation of Douglas-fir by the Douglas fir tussock moth will decrease in 1974 in all areas but one.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain pine beetle continues to kill lodgepole, ponderosa, and whitebark-limber pine in the Intermountain Region, but well below the high level experienced during the past decade.

On the Targhee National Forest in southern Idaho, tree killing is increasing in the Island Park area. However, in portions of the Moose Creek Plateau, where a relatively high level of tree mortality was expected, biological conditions took a turn for the better and mortality now appears to be on the decline. Color aerial photography, supplemented by ground surveys, indicates a significant reduction in the number of trees killed this year over last year. It is now anticipated that this downward trend will continue. To the east, in the northern part of Grand Teton National Park, the longstanding outbreak has now reached its peak and should decline. On the adjacent Bridger-Teton (formerly Teton) National Forest, heavy tree killing is now underway in Ditch Creek and other parts of the lower Gros Ventre River drainage. In most other areas of the Forest, such as the West Slope of the Wind River Range and the Greys River, tree killing continues but well below the high level of past years.

Elsewhere in parts of southern Idaho, widely scattered tree killing persists. Troublesome infestations continue in portions of the South Fork of the Boise River, Warm Springs Creek, North Fork of the Wood River, and in parts of the Twin Falls Ranger District. Salvage logging is underway but will have little overall impact on accumulated losses.

Recurrent outbreaks of a scattered nature continue to deplete lodgepole stands in portions of the Wasatch, Ashley, and Uinta National Forests, in Utah. Heaviest activity is in the upper Bear River and Provo River drainages, Wasatch National Forest; in and bordering the Flaming Gorge National Recreation Area; and to a considerably lesser extent, in the West Fork of the Duchesne River, Uinta National Forest. In the Flaming Gorge infestation, ponderosa pine is also attacked. With the exception of the Bear River infestation on the Wasatch National Forest, all other activity is on the decline. The once-serious outbreak in the high-elevation stands of ponderosa pine in Bryce Canyon National Park and adjacent Dixie National Forest continues to decline. The longstanding infestation in stagnated second-growth stands near Cascade, Idaho, continues unabated. A decline is in the offing but not until most of the suitable host trees have been killed.

During the past several years, efforts have been made to measure the annual attrition of lodgepole pine by the mountain pine beetle during an epidemic cycle in three different areas. In two of those trend areas, data have also been taken from affected trees by year of attack and emergence density, gallery length, and bark thickness. Systematic samples were taken at vertical levels in the trees for estimates of absolute populations, as well as population density (fig. 8). It is hoped that this information will provide a basis for a workable evaluation technique (if one exists) and to gain a better understanding of the interrelationships between the mountain pine beetle and its host, lodgepole pine.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Heavy tree losses by the spruce beetle have continued for the fifth consecutive year in upper Huntington Creek, Manti-LaSal National Forest, Utah. A favorable factor is that Engelmann spruce in this Region does not grow in extensive, contiguous stands which are subject to greater loss from the beetle (fig. 9). On the Manti-LaSal National Forest, spruce occurs in isolated patches on north-facing slopes, and most of these stands are now under attack. Impact surveys conducted this summer show that, in individual stands, the beetle has killed 26 to 82 percent of the merchantable spruce volume. Chemical control is not practical, but efforts are underway to salvage as much of the dead and dying timber as rapidly as possible.

Douglas fir beetle, *Dendroctonus pseudotsugae* Hopk. The most serious infestation of the Douglas fir beetle is in the north half of the Targhee National Forest, Idaho.

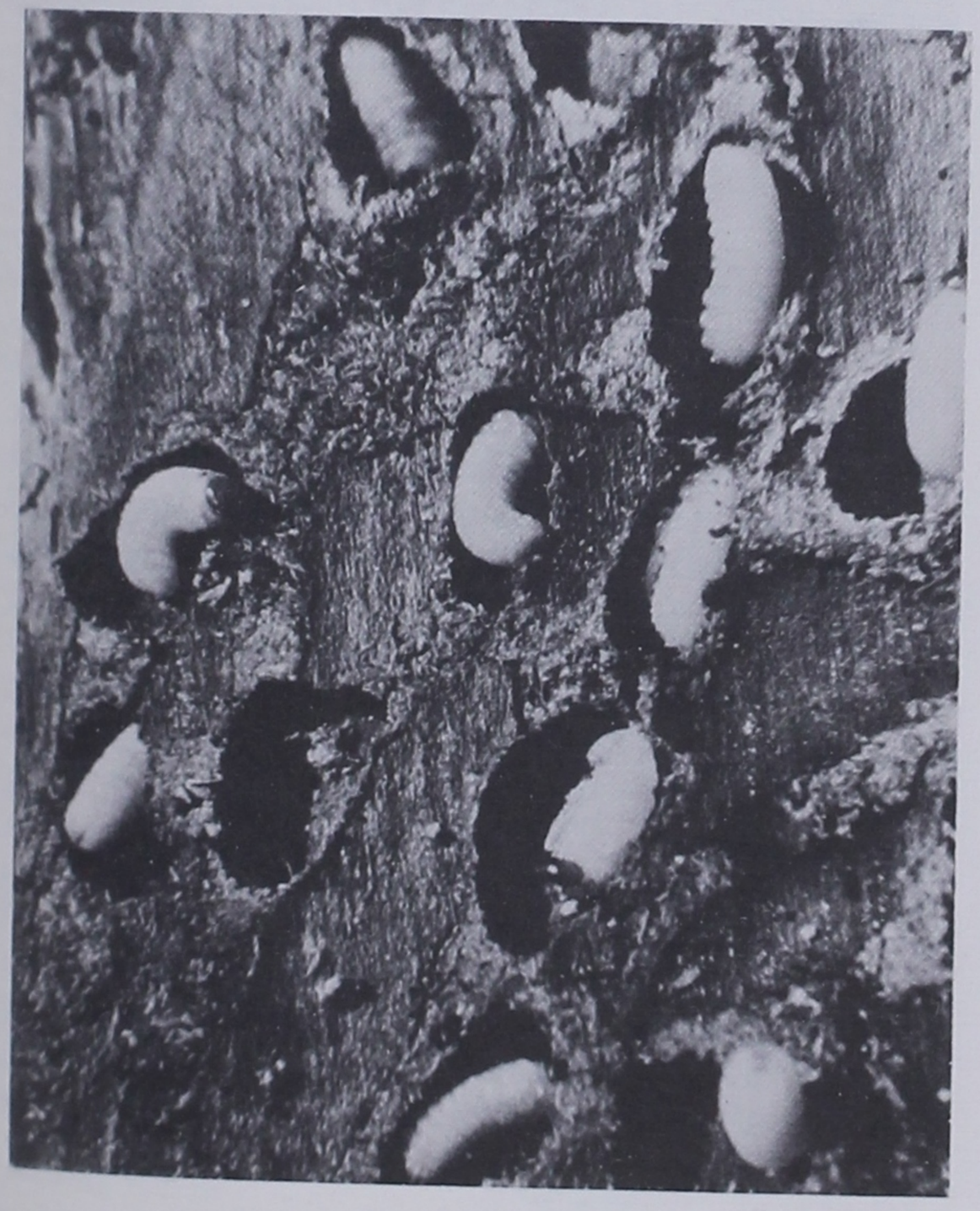
F-522801

Figure 8.–Sampling a mountain pine beetle-killed lodgepole pine as part of a study to determine the relation of various population parameters with stand attrition during an epidemic cycle.

Heavy winds and snowfall during the winter of 1968-1969 uprooted thousands of Douglas-fir trees and caused extensive breakage of many thousands more, thereby creating ideal breeding sites for beetle populations. The following spring, standing tree attacks occurred over a wide area and have continued ever since. Evaluation surveys conducted in 1973 show an even further increase in the number of standing tree attacks. Although most of the attack centers are widely scattered, the heaviest concentrations are on Bishop Mountain and north of Sheridan Reservoir. Because of the scattered nature of the outbreak, control is not practical. Efforts to salvage as much of the dead and threatened timber as possible continue.

The once serious outbreak that occurred throughout parts of the Boise, Payette, and Sawtooth National Forests for the past several years continues its downward trend. Widely scattered infestation centers persist in some areas of the Sawtooth National Forest, but at a considerably reduced rate. Salvage logging is being encouraged.

A damage survey, utilizing 35mm color aerial photography, was initiated in one severe outbreak area on the Boise National Forest near Lowman, Idaho. The procurement of ground truth and other field data has started but will not be complete until 1974. Hopefully, this information will provide some insight as to tree losses incurred during the last outbreak.



F-522802

Figure 9.–Larvae and pupae of the spruce beetle under bark of Engelmann spruce.

Ips spp. Killing of ponderosa pine by these secondary beetles occurred in conjunction with logging activities in portions of the Boise National Forest, Idaho. Mistblower application of Lindane in 110 acres of infested slash was apparently successful in minimizing attacks to nearby standing trees.

Lodgepole pines attacked and killed during epidemics of the mountain pine beetle create ideal breeding conditions for *Ips* spp. and other secondary beetles. Areas of heaviest activity are on the Targhee and Bridger-Teton National Forests in Idaho and Wyoming, respectively. These associated beetles build up in tops of trees not utilized by the mountain pine beetle. Once provided with the impetus of sheer numbers, they can successfully compete with mountain pine beetle broods in larger trees and kill many small diameter trees not preferred by the mountain pine beetle. Added to this is storm-caused debris which increases their numbers even further. This has been the situation in practically all lodgepole pine stands depleted by the mountain pine beetle and is more pronounced during the declining years of an infestation.

Western spruce budworm, *Choristoneura occidentalis* Free. The western spruce budworm has been a chronic pest of Douglas-fir and true fir forests in the Intermountain Region for many years. During the peak of the epidemic in 1967, the defoliated area covered more than 2,200,000 acres, but since then populations have been on the decline.

Only slightly more than 200,000 acres of visible defoliation was detected in 1973, compared to more than 500,000 acres in 1972. Most of the visible damage occurred on the Payette National Forest, Idaho, with considerably lesser defoliation on the Sawtooth National Forest. No defoliation was visible on the Bridger-Teton National Forest, Wyoming, which incurred upwards of 66,000 acres of defoliation in 1972. This Regionwide decline was anticipated in 1972. The 1973 evaluation surveys suggest an even further decrease in western budworm population levels in 1974.

Recent surveys show that during the past 9 years, infested stands have incurred some growth loss, negligible mortality of the understory in localized areas, and some top-kill.

Douglas fir tussock moth, *Orgyia pseudotsugata* McD. Widely separated infestations of the tussock moth, totaling over 11,000 acres, were detected in Douglas-fir stands in parts of the Sawtooth National Forest and adjacent lands. Evaluation surveys showed declining tussock moth populations in all areas but one. In the Powell Creed Area, in private ownership, moderate to heavy defoliation is expected to occur on 1,200 acres in 1974.

Less serious outbreaks of this defoliator have occurred in isolated stands of white fir, *Abies concolor,* in the Virgin and Spring Mountains of southern Nevada. Although defoliation on some 140 acres was severe, if not complete, most of the trees have refoliated. Continued feeding is predicted in the Spring Mountain infestation, but no defoliation is expected in the Virgin Mountain area.

Pine butterfly, *Neophasia menapia* (Feld. & Feld.). Pine butterfly activity increased from occasional sightings in 1968 to more than 8,000 acres of moderate to heavy defoliation in 1973 along portions of the Salmon River, Payette National Forest, Idaho. A second infestation of unknown extent was detected late in the year near Centerville, Idaho, Boise National Forest. Evaluation surveys indicate a decline in the Payette infestation in 1974 but an increase in defoliation in the Boise outbreak. Natural factors, chiefly parasitism and predation, were responsible for the decline of the Payette infestation.

A leafroller, *Archips negundanus* (Dyar). Since 1968, this defoliator of boxelder, *Acer negundo* L., has increased in both intensity and extent along the Wasatch Front in northern Utah. Particularly affected are the larger shade trees in parks, golf courses, and other recreation areas. Although some trees sustain very heavy defoliation, they refoliate quite readily (fig. 10). Since the insect does not kill trees outright, it is regarded primarily as a nuisance. The Salt Lake City Parks Department has undertaken control programs for several years using Diazinon and Sevin. The effectiveness of these programs is unknown.

F-522803

Figure 10.–Larva of *Archips negundanus* feeding on boxelder leaf.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. Dwarf mistletoe of commercial conifer species is considered the most serious disease problem in the Intermountain Region. We continue to place much emphasis on control of this disease by encouraging appropriate timber management practices and by direct control projects.

A total of 352 acres of lodgepole pine infected by *Arceuthobium americanum,* lodgepole pine dwarf mistletoe were treated this year. Two hundred acres were treated on the Ashley National Forest. One hundred and fifty-two acres were treated on the Sawtooth National Forest.

Post control evaluations of some dwarf mistletoe control projects completed in the past few years show infection levels have been reduced 46 to 89 percent, with almost all currently infected trees found to be class I as identified by Hawksworth.

Annosus root rot, *Fomes annosus.* Two *F. annosus* root rot infection centers were found this year. One on the Powder Mountain ski area near Ogden, Utah, is in

subalpine fir, *Abies lasiocarpa.* Infection court and damage is unknown as it was diagnosed in a stump bulldozed out of a ski run.

A very large area of mortality in subalpine fir on the northeast side of Bald Knoll, South Fork of the Provo River, Uinta National Forest, noted from the air several years ago, was found to be caused by *Fomes annosus.* This may be the largest infection center found in Region 4 to date. The infected strips of subalpine fir extend from the top of the mountain (elevation 9,343 feet) down to approximately the 7,400-foot level. An infection center mentioned in previous reports (Limber Pine Nature Trail, Logan Canyon, Wasatch National Forest) continues unchecked. Subalpine fir and Douglas-fir are the affected species.

NORTHERN ROCKY MOUNTAINS (R-1)[5]

by
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Conditions in Brief

Western spruce budworm damaged approximately 3.5 million acres on Douglas-fir, true fir, and Engelmann spruce forests in northern Idaho and Montana. Douglas fir tussock moth defoliated nearly 100,000 acres of mixed Douglas-fir and true fir in northern Idaho and mixed State and private land near Colville, Wash., and 350 acres of Douglas-fir in western Montana. Larch casebearer caused heavy defoliation of larch at lower elevations in northern Idaho, northwestern Montana, and eastern Washington. Pine butterfly populations declined on the Bitterroot and Lolo National Forests of Montana and Nezperce National Forest, Idaho. Several thousand acres of Douglas-fir were defoliated by the false hemlock looper near Bigfork and Somers, Mont. The western hemlock looper infestation increased on the St. Joe and Clearwater National Forests, Idaho.

Foliar damage was caused by a complex of defoliators on 5,000 acres of lodgepole pine on the Flathead National Forest and in Glacier National Park, Mont. The Bruce spanworm defoliated more than 15,000 acres of quaking aspen in the Turtle Mountains of North Dakota. A pine sawfly defoliated 10,000 acres of lodgepole and ponderosa pine reproduction in the Kootenai National Forest, Mont. The variable oakleaf caterpillar caused light defoliation of basswood, paper birch, and bur oak in North Dakota. White pine weevil top-killed spruce reproduction throughout the Region. The California tortoise shell butterfly defoliated 1,200 acres of shiny leaf ceanothus near Seeley Lake, Lolo National Forest, Mont., and several hundred acres in the Sundance burn, Idaho Panhandle National Forests.

White pine stands continue to sustain heavy losses by mountain pine beetle on the Clearwater National Forest, Idaho, and new outbreaks occurred in white pine stands on the Colville National Forest in eastern Washington. The massive infestation in lodgepole pine stands increased on the Gallatin National Forest, Mont., and in Yellowstone National Park, Wyo. Mountain pine beetle continued to deplete second-growth ponderosa pine stands on the Lolo National Forest, Mont. New infestations developed in lodgepole pine stands on the Helena and Lewis and Clark National Forests, Mont.

Douglas fir beetle infestations declined for the second consecutive year in the North Fork Clearwater River drainage, Idaho. Pine engraver beetle infestations increased in second-growth ponderosa pine stands along the Clark Fork River drainage in western Montana, and on the Clearwater National Forest, Idaho. A Douglas fir engraver beetle caused top-kill of Douglas-fir along Dworshak Reservoir near Orofino, Idaho. Western pine beetle killed many small groups of ponderosa pine on the Nezperce National Forest, Idaho.

Root decay fungi, *Poria weirii* and *Armillaria mellea,* were found to be causing mortality in young Douglas-fir-ponderosa pine plantations, and *Fomes annosus* was found contributing to mortality in 200- to 300-year-old ponderosa pine stands. Dwarf mistletoe control activities were decreased from 1972 due to limited funds. Annual impact of dwarf mistletoes on the Flathead Indian Reservation has been estimated to be $123,750. In general, foliage diseases were spotty in occurrence and locally severe in certain areas. Elytroderma needle blight was probably the most damaging foliage disease. At the Coeur d'Alene nursery significant numbers of spruce, grand fir, and Douglas-fir seedlings died. They were colonized by root pathogens. Losses were as high as 30 to 40 percent in some beds.

Noninfectious (abiotic diseases) were widely evident during 1973. Trees on approximately 13,500 acres in the Blackfoot Valley of Montana suffered winter injury. Drought symptoms were noted on several coniferous species, particularly in northern Idaho. Air pollutants were implicated as causing damage to approximately 5,000 acres of Douglas-fir around Missoula, Mont., and to vegetation near Butte, Mont. A significant growth reduction of lodgepole pine caused by an air pollutant-insect complex was measured near Columbia Falls, Mont.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. Area of western spruce budworm infestation decreased from 4.6 million acres in 1972 to 3.5 million acres in 1973. Defoliation decreased noticeably on all

[5] Includes forested lands in Montana, North Dakota, northern Idaho, northeastern Washington, northwestern South Dakota, and Yellowstone National Park.

Forests east of the Continental Divide and in Yellowstone National Park. A new outbreak was detected on 9,000 acres along the Madison River, Beaverhead National Forest, Montana. Infestations decreased in intensity on the eastern half of the Lolo National Forest and on the Flathead Indian Reservation. Defoliation intensity and the acreage infested increased in the Bitterroot National Forest and the western half of the Lolo National Forest, Montana. The greatest defoliation increase in area and intensity occurred on the Red Ives Ranger District, Idaho Panhandle National Forests, where the outbreak spread from 66,500 acres in 1972 to 146,000 acres in 1973. Aerially visible defoliation remained at about 1.3 million acres on the Nezperce National Forest, Idaho. Prolonged feeding for several years has caused extensive top-kill and tree mortality on the Clearwater and Nezperce National Forests in Idaho, and Lolo and Flathead National Forests in Montana. Budworm damage has also affected regeneration programs on these Forests by virtually eliminating the seed source in many areas. Cones are destroyed by direct feeding and indirectly because trees, weakened from repeated defoliation, fail to produce cone crops. As a result, the Nezperce, Clearwater, and Lolo National Forests are contemplating establishing seed orchards to be closely managed for regeneration purposes. Severe damage is expected in western portions of the Region in 1974.

Douglas fir tussock moth, *Orgyia pseudotsugata* McD. The Douglas fir tussock moth outbreak mushroomed from small localized infestations in 1972 to 104,550 acres in 1973. The largest concentrated area of defoliation was 70,000 acres on the Palouse Ranger District, Idaho Panhandle National Forests. Defoliation of 23,000 acres of mixed Douglas-fir-grand fir type occurred on the Selway and Salmon River Ranger Districts, Nezperce Forest, Idaho. Aerially visible defoliation occurred on 5,200 acres of private lands along the Columbia River in northeastern Washington. Four thousand acres of mixed Douglas-fir and true fir stands were moderately to severely defoliated on private lands in the Craig Mountains south of Lewiston, Idaho. Two small areas (50 and 300 acres) of Douglas-fir suffered heavy defoliation near Missoula, Mont. Tree mortality is expected in stands severely defoliated in 1973 (fig. 11). Egg mass surveys indicate further defoliation will occur in 1974. The extent of control for 1974 is under study. Plans are being developed to pilot test two microbial insecticides, *Bacillus thuringiensis* Ber., and a naturally occurring polyhedrosis virus in 1974.

F-522804

Figure 11.–Douglas-fir suffering complete defoliation by Douglas fir tussock moth.

Larch casebearer, *Coleophora laricella* (Hbn.). Larch casebearer caused heaviest damage in western larch stands below 3,000 feet elevations where up to 100 percent of the needles were destroyed in some areas in northern Idaho. Moderate to heavy foliar damage occurred to larch stands around Flathead Lake, Columbia Falls, and the Swan Valley in northwestern Montana. An imported parasite, *Chrysocharis laricinella* (Ratz.) was released to establish this parasite as a biological control agent in selected larch stands near Moscow, Idaho, and near Evaro, Mont.

Pine butterfly, *Neophasia menapia* F. and F. Infestations on the Bitterroot and Lolo National Forests in western Montana and the Nezperce National Forest in Idaho declined by the end of 1973. Egg and larval predation by pentatomids, poor egg viability, pupal parasitism, and starvation due to depletion of needles by heavy larval populations were significant factors responsible for the population decline. The chemical Zectran and the biological agent *Bacillus thuringiensis* Ber. (*B.t.*) were field tested against the pine butterfly in 1973 (fig. 12). Two concentrations of each material (Zectran 0.15

F-522805

Figure 12.–Helicopter spraying pine butterfly infested plot (Bitterroot National Forest, Mont.)

pound per gallon per acre and 0.30 pound per gallon per acre; *B.t.* 0.5 pound per 2 gallons per acre and 1 pound per 2 gallons per acre) were tested. Each treatment, except the 0.5 pound *B.t.*, effected excellent (90+ percent) population reductions. Both materials are good candidates for pilot testing. Egg mass surveys show light to negligible defoliation is expected in 1974.

Western false hemlock looper, *Nepytia freemani* Mun. This defoliator reached epidemic proportions for the first time since 1964 in the Northern Region (fig. 13). Light defoliation was observed in the upper crown of Douglas-fir trees on about 3,500 acres around the north end of Flathead Lake near Bigfork and Somers, Mont. Some parasitism was observed in larval and pupal populations. Surveys of egg densities are planned to determine population trends for 1974.

Western hemlock looper, *Lambdina fiscellaria lugubrosa* Hulst. Infestations declined in areas defoliated in 1972, but 11,200 acres of mountain hemlock received light defoliation on the Canyon Ranger District, Clearwater National Forest. Infestations are expected to remain at about the same level or decline in 1974.

A sawfly, *Neodiprion* sp. Populations of this sawfly caused moderate to heavy defoliation of lodgepole pine and ponderosa pine reproduction on 10,000 acres in the Wolf Creek and East Fork Fisher River drainage, Kootenai National Forest, Mont. Heaviest damage occurred in naturally seeded areas on trees 20 feet or less in height. Egg surveys indicate populations will decline in 1974.

Defoliator complex. A needle miner, *Evagora* sp.; the pine needle sheath miner, *Zelleria haimbachi* Busck.; and the sugar pine tortrix, *Choristoneura lambertiana* (Busck.), caused variable defoliation on 5,000 acres of lodgepole pine on Teakettle Mountain, on the Glacier View Ranger District, Flathead National Forest, and in Glacier National Park, Mont. Two-year and older needles were mined by the needle miner, while the pine needle sheath miner and sugar pine tortrix defoliated new growth.

F-522806

Figure 13.–Larva of the false hemlock looper (Flathead National Forest, Mont.).

Bruce spanworm, *Operophtera bruceata* (Hulst). More than 15,650 acres of quaking aspen in the Turtle Mountains of North Dakota showed light to heavy defoliation during the spring of 1973. Heavy defoliation occurred in many stands. Egg mass surveys are planned to estimate population trends for 1974.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The number of western white, lodgepole, and ponderosa pines killed by the mountain pine beetle in 1973 increased over 1972. Most white pine mortality occurred on private lands and State of Idaho lands in the North Fork Clearwater River drainage, where stands suffer about 10-percent mortality annually. Active infestations occurred in Yellow Dog and Downey Creek drainages of the Coeur d'Alene River. New infestations appeared in the Sullivan Creek drainage east of Sullivan Lake in the Idaho Panhandle National Forests. Chronic infestations continue in stands infected with white pine blister rust *(Cronartium ribicola* Fisch.) in north Idaho.

Mountain pine beetle populations increased in second-growth ponderosa pine stands in Ninemile drainage, Bureau of Land Management, State, private, and Lolo National Forest lands along the Clark Fork and Blackfoot River drainages north and east of Missoula, Mont; also, in second-growth stands on mixed State, private, and Federal lands near Marysville, Unionville, and Lump Gulch, Mont. Several hundred ponderosa pines were killed on the Flathead Indian Reservation in second-growth stands between St. Ignatius and Flathead Lake in western Montana, and several hundred more in Corral and Thompson Creek drainages on the Crow Indian Reservation in eastern Montana. Epidemic infestations occur in ponderosa pine stands in the West Fork Bitterroot River drainage, Bitterroot National Forest, Mont. Small infested groups of ponderosa pines were detected throughout the Lewis and Clark National Forest, Mont. Epidemic conditions persist in lodgepole pine stands in the West Gallatin River drainage, Gallatin National Forest, Mont; Yellowstone National Park, Wyo; Glacier National Park, Mont; and on the Lincoln Ranger District, Helena National Forest. A new outbreak developed in the Yaak River Drainage, Kootenai National Forest, Mont.

Douglas fir beetle, *Dendroctonus pseudotsugae* Hopk. Ground surveys and population sampling showed that the massive outbreak in the North Fork Clearwater River drainage near Orofino, Idaho, declined sharply in 1973, with an estimated 735,545 board foot volume being killed. Infested tree groups were significantly smaller than occurred in 1971 and 1972. New infestations developed along the St. Joe River in the Idaho Panhandle National Forests; in Fish Creek drainage, Middle Fork of Clear Creek, and in major tributaries of the South Fork Clearwater River, Nezperce National Forest, Idaho; in tributaries of the Clark Fork River east of Missoula, Mont., and in the East Fork Bitterroot River drainage, Bitterroot National Forest, Mont. Beetle activity declined to a low level in trees weakened by "winter drying" in the Bridger Mountains, Gallatin National Forest, Mont. The extreme dry season experienced in 1973 could weaken trees and precipitate increased beetle activity in 1974.

Pine engraver beetles, *Ips* spp. Infestations increased in 1973. New outbreaks developed in the Garnet Mountain Range along the Clark Fork River from Drummond downstream to St. Regis, Mont., and several thousand ponderosa pine were killed on the Flathead Indian Reservation in Montana. Minor beetle activity was observed on the Slate Creek Ranger District, Nezperce National Forest, Idaho. *Ips* spp. associated with mountain pine beetle top-killed ponderosa pine in many forests of western Montana. Logging activity promoted *Ips* buildups resulting in mortality of ponderosa pine stands in several localities near Deary, Idaho.

Fir engraver beetle, *Scolytus ventralis* Lec. Most severe tree mortality occurred in grand fir stands near Coeur d'Alene Lake and on the Mica, Fernan, and Wallace Ranger Districts, Idaho Panhandle National Forests. Many fir engraver infestations were associated with root rot centers. Tree killing decreased in grand fir

stands on the Clearwater Ranger District, Nezperce National Forest, Idaho. New infestations developed in Douglas-fir adjacent to cutover areas in the Big Belt Mountains, Townsend Ranger District, Helena National Forest, Mont. Infestations are expected to continue at epidemic levels in 1974.

Other insects. A Douglas fir engraver beetle, *Scolytus tsugae* (Sw.), killed and top-killed several hundred Douglas-fir around Dworshak Reservoir near Orofino, Idaho. Lower bole sections of top-killed trees were attacked by Douglas fir beetle and the flatheaded fir borer, *Melanophila drummondi* (Kirby). Extremely dry weather conditions experienced this year may stress trees and result in increased tree killing by *M. drummondi* in 1974. The variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.), caused light, widely scattered defoliation of paper birch, American basswood, and bur oak in the Killdeer and Turtle Mountains and on the Fort Totten Indian Reservation in North Dakota. The white pine weevil, *Pissodes strobi* Peck, top-killed spruce reproduction in open-grown spruce stands throughout the Region. Damage is expected to increase as cutover areas are regenerated. The California tortoise shell butterfly, *Agalis californica* Boisduval, defoliated 1,200 acres of shiny leaf ceanothus near Seeley Lake, Mont., and in the Sundance burn in northern Idaho. Larval populations of the forest tent caterpillar, *Malacosoma disstria* Hbn., defoliated birch, hawthorn, and other broadleaf species along river bottoms near Coeuur d'Alene and St. Maries, Idaho, and the Jocko River in Montana, and elms in the city of Billings, Mont.

The alder flea beetle, *Altica bimarginata* Say, completely defoliated alder on several hundred acres along the Lochsa River in northern Idaho. Feeding by nymphs and adults of a lacebug, *Corythucha scitula* Drake, caused yellowing of leaves and early leaf drop of alder on the Kelly Creek and Canyon Ranger Districts, Clearwater National Forest, Idaho. The rusty tussock moth, *Orgyia antiqua* (Linn.), defoliated numerous browse species on the Clearwater National Forest, Idaho, and Lolo National Forest, Mont. Cooley spruce gall aphid, *Adelges cooleyi,* caused yellowing of needles of reproduction and pole size Douglas-fir throughout much of the Flathead National Forest and in widely scattered areas of the Lolo National Forest, Mont. The spring cankerworm, *Paleacrita vernata* (Peck), continued to cause noticeable defoliation of Siberian elm shelterbelts in North Dakota. Fall cankerworm, *Alsophila pometaria* Harr., defoliated green ash in the North Dakota Badlands.

Status of Diseases

Root diseases. Remote sensing techniques have been found to be highly reliable in the detection of root disease centers in some stands in the Idaho Panhandle National Forests. As much as 80 percent of some of these stands are visibly affected by root disease.

Utilizing remote sensing techniques, a root disease impact survey is currently being conducted on the old Coeur d'Alene National Forest portion of the Idaho Panhandle National Forests. Although a complex of at least seven fungi are apparently involved, the most abundant pathogens seem to be *Poria weirii* (Murr.) Murr. and *Armillaria mellea* (Vahl ex Fr.) Kumm (fig. 14).

Armillaria mellea and *Fomes annosus* (Fr.) Cke. were found contributing to mortality in 200- to 300-year-old ponderosa pine in the Lone Pine area of the Flathead Indian Reservation. Numerous overmature ponderosa pine have been dying in the area for several years, and in many cases mortality was attributed to western pine beetle, *Dendroctonus brevicomis.* Several 1973 faders with beetles were bulldozed over and roots examined. In one case, advanced decay caused by *Fomes annosus* was found in over 90 percent of the tree's roots. However, in another case, only minor amounts of *Armillaria mellea* were present (fig. 15).

On the Selway Ranger District of the Nezperce National Forest, approximately 3,000 acres of young, mixed composition (primarily Douglas-fir) plantations were inventoried for information including mortality caused by root disease. *Armillaria mellea* and *Poria weirii* were found killing ponderosa pine, Douglas-fir, and grand fir seedlings and saplings. Although survey data are not available at this time, observations indicate that very little mortality caused by root pathogens is occurring.

Stem decays. Isolations made from subalpine fir, Engelmann spruce, and Douglas-fir which had been scarred during a selective logging operation approximately 10 years previously in nearly all cases yielded *Stereum sanguinolentum* (Alb. and Schw. ex Fr.) Fr. Although only a relatively few wounds were evaluated, these preliminary results indicate that care should be taken to avoid wounding residual trees in selective cutting operations.

Dwarf mistletoes. *Arceuthobium* spp. were controlled on approximately 4,000 acres. More acreage would have been worked, but some of the allotted funds were withdrawn to combat insect outbreaks in other Regions.

Data from inventory plots on the Flathead Indian Reservation show an annual loss to dwarf mistletoes of $0.63 per acre. Expanding this to the entire reservation gives an annual loss of $123,750.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Moreau was recovered from one American elm in Missoula, Mont. This is the first record of the occurrence of this pathogen in Montana. The fungus was also found causing mortality in the Bismarck, Mandan, and Fargo areas of North Dakota.

F-522807

Figure 14.–Laminated root rot of *Abies grandis*. *Poria weirii* alone or in combination with one to six other decay fungi cause this type of damage in northern Idaho.

F-522808

Figure 15.–Fruiting bodies (mushrooms) of the root pathogen *Armillaria mellea*.

Needle casts. *Elytroderma deformans* (Weir) Darker was particularly severe on ponderosa pine in the Bitter Root Valley and Flathead Valley of Montana. It was observed to be of widespread occurrence primarily on ponderosa pine but also on lodgepole pine in northern Idaho.

Lophodermella arcuata (Darker) Darker was of localized occurrence in the Coeur d'Alene River and Hayden Creek drainages of the Idaho Pahnandle National Forests.

Lophodermium pinastri (Schrad. ex Fr.) Chev. caused minor defoliation of natural ponderosa pine in isolated areas of the Flathead Indian Reservation near Arlee, Mont., and in the Hayden Creek area of the Idaho Panhandle National Forests. This fungus, or one very close to it, is causing moderate defoliation of planted ponderosa pine in areas of the Idaho Panhandle National Forests near Bonners Ferry, Idaho, and also in the Hayden Creek area.

Lophodermella concolor (Dearn.) Darker was locally heavy on lodgepole pine in areas of the Colville National Forest east of Colville, Wash., and in the Hellroaring Creek area of the Bitterroot National Forest in Montana.

Rhabdocline pseudotsugae Syd. caused severe defoliation of Douglas-fir in the Lochsa River drainage, but was infrequently found elsewhere.

Needle rusts. Needle rusts, *Pucciniastrum* spp., were found on grand fir in the Beauty Creek, Rutherford Gulch, and Boundary Peak areas of the Idaho panhandle National Forests. Seedlings and saplings were moderately affected with up to 40 percent of current year's foliage being damaged in some cases.

Other foliage diseases. *Lecanosticta* sp. (needle blight of western white pine), caused severe defoliation of western white pine in localized areas of the Priest River and Coeur d'Alene River drainages of the Idaho Panhandle National Forests. As much as one-third of the entire lower crown of many trees was completely defoliated, probably due to a combination of suppression and the fungus.

Red band needle blight, caused by *Scirrhia pini* Funk and Park, was of moderate severity in ponderosa pine stands in the Lochsa River and Priest River drainages.

Nursery diseases. Seedling losses at the Coeur d'Alene nursery were 30 to 40 percent or higher in some nursery beds. Affected were 2-0 Engelmann spruce, and 1-0 Douglas-fir and grand fir. Isolations, made from dead and dying seedlings, in a high percentage of cases, yielded two or more *Fusarium* spp. Although known pathogens are found in the affected seedlings, their presence is probably the result of improper nursery bed conditions rather than the sole cause of the mortality.

Winter injury was especially severe on 2-0 spruce in the nursery, but trees generally recovered and grew rapidly during the summer. No correlation between winter injury and incidence of root pathogens was evident.

Pole blight. Previously found only in natural western white pine stands, pole blight has been identified by Intermountain Forest and Range experiment Station pathologists in several 35- to 45-year-old western white pine plantations around Deception Creek on the Idaho Panhandle National Forests.

Drought. Various amounts of abnormal defoliation of western redcedar, grand fir, and ponderosa pine were observed in the Idaho Panhandle National Forests. This defoliation is probably due to the droughty conditions which occurred during the winter of 1972-73 and hot, dry conditions which occurred during the summer of 1973. Western redcedar was severely affected in some areas and may result in a minor amount of mortality.

Winter damage (red belt). In the Blackfoot Valley of western Montana, it was determined by aerial survey procedures that 13,500 acres of ponderosa pine were subjected to winter damage during the winter of 1972-73. Damage on 12,340 acres was classified as light, 800 acres as medium, and 360 acres as severe. Very light damage to ponderosa pine was noticed in other parts of western Montana, including the Clark Fork Valley east and west of Missoula, the Bitter Root Valley, and the Flathead Valley. Trees are not expected to die.

Air pollutants. A diseased condition of Douglas-fir was noted in February 1973 adjacent to a papermill near Missoula, Mont. The 2-year and older foliage had developed partial (tip) to complete necrosis. An aerial survey was made and visible injury was found over 5,000 acres of Federal, State, and private lands. It was concluded that insects and pathogenic fungi were not responsible. Winter damage as a cause was also ruled out. Sulfur concentrations in affected tissue reached as high as 30 times that found in needles from control areas. High amounts of total sulfur and considerable sulfur dioxide were found in the air within the affected area. The most probable explanation of cause was determined to be excessive sulfur in the reduced and oxidized forms. Large amounts of reduced sulfur and moderate amounts of sulfur dioxide are emitted from mill stacks.

An estimated total merchantable volume of 3,108,891 board feet is affected; 672,205 board feet (22 percent) are in the none-to-lightly affected category, 1,779,469 board feet (57 percent) are in the moderate, and 657,217 board feed (21 percent) are in the severe category. Not many of the trees were dead. If fumigation continues as is expected, considerable mortality will occur.

Clinical effects of fluorides emitted from the Anaconda Aluminum Plant at Columbia Falls, Mont. have been documented. Data from Stage II examination of 22 separate stands in the area showed a rather consistent significant reduction in growth attributable to the fluoride-insect complex present in the area. This reduction was independent of site or weather factors. The impact in terms of board-foot loss has not yet been calculated.

A chemical plant producing elemental phosphorous near Butte, Mont., emits hydrogen fluoride. Although little fluoride injury was found on vegetation during a detection survey around the facility, the amounts accumulated by plants represent a threat to foraging animals that consume that vegetation.

CENTRAL ROCKY MOUNTAINS (R-2)

by

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Conditions in Brief

The mountain pine beetle is the most serious forest insect pest in the Central Rocky Mountains. Epidemic infestations in ponderosa pine in the Black Hills and along the Colorado Front Range continued to increase. The beetle is also a problem in lodgepole pine on the Arapaho, Medicine Bow, and Shoshone National Forest. Adjacent State, private, and other Federal lands are also infested.

There are no epidemic infestations of the spruce beetle in the region at this time. This insect has been a major problem in the past. The western spruce budworm caused light to moderate defoliation in and adjacent to the San Isabel and Roosevelt National Forests this year. A slight increase in defoliation is expected for 1974.

Various insects are causing minor damage throughout the region, and there are a number of insect problems in the shelterbelts and urban areas of the Plains States.

Dwarf mistletoes, as a group, received the greatest amount of attention in the detection, evaluation, and suppression of forest tree diseases. Efforts to suppress the disease were continued on lodgepole pine commercial forest lands in Wyoming and Colorado. Dutch elm disease was detected in previously unreported areas in Nebraska, South Dakota, and Colorado. Native elm populations, where present, continued to be a reservoir for the spread and intensification of the disease. Infectious and noninfectious foliage diseases were quite prominent on different hosts in various parts of the Region. Anthracnose on American sycamore was very common in eastern Kansas and Nebraska causing moderate to severe defoliation.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. This beetle is the most serious insect pest in the region. There are several outbreak areas causing extensive tree mortality. The pest attacks both ponderosa and lodgepole pine. The most serious infestations are in ponderosa in the Black Hills of South Dakota and Wyoming, and along the Front Range of Colorado.

The epidemic in the Black Hills has been active for over a decade and continued to increase. During the late 1960's, the epidemic retracted to the northern Black Hills, but during the last 2 years the infestation has again spread southward. Concentrated tree loss is prevalent in dense second growth stands where the basal area is high and growth is stagnated. Past efforts at control relied heavily on the use of ethylene dibromide for chemical treatment, supplemented by cutting and burning of the infested trees. The emphasis now is to reduce stand stocking in susceptible stands. Thinned stands are virtually free of mountain pine beetle activity. An energetic program of timber sales and salvage logging has been implemented mainly in the heavy beetle activity areas to suppress beetle populations and to bring the stand under management. In the past year 165,000 trees were salvage logged.

Along the Front Range there is also a problem of stagnated stands caused by poor site conditions, overstocked stands, and the widespread presence of dwarf mistletoe. The problem along the Front Range is further complicated by suburban development. Control is difficult due to the large number of small private forest landowners and the intermingled State and Federal lands. The Colorado State Forest Service has confined their chemical control program to those areas where private landowners are organized to carry out suppression on logical treatment units.

The infestation was found from Colorado Springs to the Wyoming State line, mostly at the lower to mid-elevation range of ponderosa pine. There are probably 500,000 infested trees on all landownerships along the Colorado Front Range.

There was scattered loss of ponderosa pine on private and Federal lands along the eastern slope of the Bighorn Mountains in Wyoming. This area has a long history of mountain pine beetle infestations. Losses in 1973 increased over those of the preceding year.

In lodgepole pine, a relatively large infestation is present in the Middle Park area of Colorado. The infestation has been building and spreading since first being detected in 1968. Infested trees are on private, National Forest, Bureau of Land Management, and Rocky Mountain National Park lands.

Two infestation areas approximately 15 miles apart are developing on the Medicine Bow National Forest in Wyoming. The infestation along South Spring Creek probably began in 1969 and the infestation on Green Ridge began in 1971. The intervening land is forested with susceptible lodgepole, and if both infestations continue to build and spread, heavy loss could develop.

The infestation remains active near South Pass City and Atlantic City on Bureau of Land Management and Shoshone National Forest land in Wyoming.

There is a 500 acre infestation along Harrison Creek near Steamboat Springs, Colo.

Some tree mortality continues in the suburban developments around Dillon Reservior in Colorado. Tree

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[6]The following organizations contributed information for this report: Cooperative Extension Services of Kansas, Nebraska, and South Dakota, South Dakota State Division of Forestry, Wyoming State Department of Agriculture, Colorado State Forest Service, and the Rocky Mountain Forest and Range Experiment Station.

loss in those developments greatly reduces the real estate values.

The infestations on Cold Springs Mountain in extreme northwestern Colorado have subsided considerably.

Spruce beetle, *Dendroctonus rufipennis* (Kby.) Spruce beetle activity was very low in 1973. The potential for a beetle population buildup continued in windthrow areas on the Rio Grande, San Juan, and Medicine Bow National Forests. Trees in the first two areas were blown down in October 1971, whereas blowdown in the latter area occurred over a several year period along the edge of timber harvest units. These trees may be attractive to the beetles for several years because the root systems are only partially destroyed when the tree falls.

Douglas fir beetle, *Dendroctonus pseudotsugae* Hopk. This bark beetle continues to cause minor losses in scattered areas throughout the region. Mortality generally occurs in small groups on steep, rocky drainages. There are no infestation areas of significant size.

Pine engraver, *Ips pini* Say. A fire near Chadron, Nebr., seriously burned 3,600 acres. Much of this was in ponderosa pine. Eight hundred acres were on the Nebraska National Forest, 160 acres were on the Chadron State Park, and the remainder on private lands. Past experience with the pine engraver in this area indicated that large populations could develop in trees weakened by fire. These populations then emerge and attack adjacent green trees. A plan was developed to log and remove fire-weakened trees before the beetles developed large populations. Trees on all landownerships would be removed.

Western spruce budworm, *Choristoneura occidentalis* Freeman. Budworm defoliation slightly increased this year especially along the Poudre River on the Roosevelt National Forest, on State and private lands west of Ft. Collins, west of Boulder, and in portions of Rocky Mountain National Park, all in Colorado. The San Isabel National Forest, which ordinarily experiences the heaviest budworm defoliation of any area in the region, sustained light to moderate defoliation. Based on data collected during an egg mass survey conducted during the late summer there will be light and moderate defoliation along the Front Range of Colorado from Boulder to Ft. Collins and west into Rocky Mountain National Park in 1974. Some light and moderate defoliation is also expected in the San Isabel National Forest.

Pine tortrix, *Choristoneura lambertiana ponderosana* Obraztsov. This insect is also known as the sugar pine tortrix in other Western States. An infestation on ponderosa pine along the St. Vrain and Big Thompson canyons of the Roosevelt National Forest caused heavy defoliation. The insect was also observed near Pagosa Springs in the San Juan Mountains. Defoliation of the tops of trees and lateral branches might cause problems if the infestation persists.

Pine butterfly, *Neophasia menapia* (Feld & Feld). This insect is present on several thousand acres around Keystone in the Black Hills of South Dakota. This is the third summer that large numbers of adults have been observed in the area. Larvae were also collected. Defoliation is light to unnoticeable at the present time. Flying adults were also observed in small numbers along the Front Range of Colorado.

Douglas fir tussock moth, *Orgyia pseudotsugata* McD. The population of this insect which had caused heavy defoliation on Colorado blue spruce on the Ft. Carson military base has died out. Heavy defoliation was reported on some ornamental blue spruce in Denver.

Lodgepole terminal weevil, *Pissodes terminalis* Hopp. This weevil continues to cause damage to lodgepole pine saplings. The insect is known to be present in the Routt, Roosevelt, and Medicine Bow National Forests.

Pine shoot moth, *Eucosma sonomana* Kearf. This insect caused severe growth deformities in young ponderosa pine, 5 to 20 feet tall, near Turkey Springs Guard Station in the San Juan National Forest. The larvae bore into the new shoots causing terminal mortality, retarded growth and deformity resulting in dominance of the laterals. This caused the formation of multiple leaders and deformity of the trees. Damaged trees can be found in most of the ponderosa pine stands on the San Juan National Forest.

Pitch nodule moth, *Petrova arizonensis* (Hein) For several years this insect has caused stunting and deformity of pinyon pine in a large area of Colorado extending from Buena Vista to Salida to Canyon City. Damage can be very noticeable with some tree mortality resulting from several years repeated infestation. During the past year the incidence of this insect has dropped greatly.

Tip moths. The western pine tip moth, *Rhyacionia bushnelli* Busck, and the southwestern pine tip moth, *Rhyacionia neomexicana* Dyar, were present in pines in windbreaks and pine plantings in Nebraska and Kansas. They caused stunting and deformity by infesting and killing the terminals and some laterals. The southwestern pine tip moth was found in Colorado all along the Front Range and across the southern portion of the State to the San Juan Mountains. This insect can cause severe damage anywhere young pines are found in this area. Another tip moth, *Dioryctria* sp., caused extensive

damage to terminals of pinyon pine in Owl Canyon north of Ft. Collins, Colo.

Needle Miners. These insects caused damage in ponderosa pine, pinyon pine, and white fir in Colorado. A miner, *Coleotechnites* sp., reported last year on ponderosa pine west of Boulder, Colo. suffered a severe drop in population and was no longer a problem. It had infested about 9,000 acres. Another *Coleotechnites* sp., infested pinyon pine in Denver, Salida, and Durango. Defoliation was noticeable only in the Durango area. A miner tentatively identified as *Epinotia meritana* Hein., has caused moderate to heavy defoliation of white fir near North La Veta Pass for 2 years (fig. 16). In 1973 there was about 3,000 acres of heavy defoliation and light defoliation on another 10,000 acres on Sheep and Iron Mountains.

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Figure 16.–Trees without needles are white fir which were defoliated by white fir needle miner and trees with needles are Douglas-fir.

Strawberry root weevil, *Otiorhynus ovatus* (L.) This weevil which caused the loss of 400,000 spruce seedlings in the Mt. Sopris Tree Nursery, White River National Forest, in 1972, again caused losses in 1973. Control measures reduced the loss, but the weevils damaged between 1 and 2 percent of the spruce seedlings lifted in 1973. Efforts to suppress the damage caused by this beetle were continued.

Aspen leaf miner, *Phyllocnistis populiella* Chamb. This leaf miner was found in the Lead-Deadwood area and along Spearfish Canyon in the Black Hills National Forest. The miner caused severe defoliation in some areas. The damage associated with leaf scorch was caused by a very hot, dry period in July. Long-term or permanent damage is probably negligible.

Red-humped oakworm, *Symmerista canicosta* Franc. This insect is ordinarily a pest in the Northern Lake States. In 1972, and again in 1973, the insect was found in eastern South Dakota between Newton and Sioux Falls. Noticeable defoliation occurred around Newton in oak (fig. 17).

F-522810

Figure 17.–An oak leaf with feeding larvae of red-humped oakworms.

Fruit tree leaf roller, *Archips argyrospilus* (Walker). In the past 2 years this insect has caused moderate defoliation on mountain mahogany, chokecherry, skunkbrush, and wildrose along the western edge of the Black Hills National Forest. This year damage from this insect was minimal.

Other insects. In addition to damage from tip moths in Nebraska and Kansas, several other insects were reported causing damage in the Plains States. The elm leaf beetle, *Pyrrhalta luteola* (Muller) defoliated elms in Wyoming, South Dakota, Kansas, and Nebraska. The spring cankerworm, *Paleacrita vernata* (Peck), caused severe defoliation of shelterbelts in South Dakota, and in north central and northeastern Nebraska. It was also found in Wyoming. The bagworm, *Thyridopteryx ephemeraeformis* (Haworth) was a pest in eastern Kansas and was found on eastern red cedar in eastern South Dakota. Two species of the forest tent caterpillar, *Malacosoma* spp., defoliated hardwoods in northeastern South Dakota. Some aerial spraying was conducted for suppression of these caterpillars. The walnut caterpillar, *Datana intergerrima* G & R, defoliated walnut and the yellow-necked caterpillar, *Datana ministra* (Drury), defoliated pine oak in eastern Kansas. Lilac, birch, and poplar borers were also reported in South Dakota.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex Engelm. was controlled on 800 acres in Colorado and Wyoming. An extensive type evaluation survey was completed in a 10,000-acre timber management unit in the Roosevelt National Forest to determine the need for control.

A study of the significance of stem infections in the spread of *A. americanum* was conducted in the Medicine Bow and Routt National Forests. Over 1,300 stem infections on 1,000 seedling to sawtimber size trees, were carefully examined for different characteristics related to seed production and spread potential. A report on the results of the study will be published elsewhere. In another study, a 16-unit campground in the Shoshone National Forest, containing mostly dwarf mistletoe infected lodgepole pine, was examined to appraise the condition of the trees in the immediate vicinity of each unit (fig. 18). The data will be used to develop recommendations that the land manager can use to prolong the life of the trees and improve the general condition of the campground.

Limber pine dwarf misteltoe, *A. cyanocarpum* Coulter and Nels. was discovered in two previously unreported areas in the Bighorn Mountains in Wyoming. Tree mortality was evident in one large infection center covering several acres.

Heavy brooming caused by Pinyon dwarf misteltoe, *A. divaricatum* Engelm. on *Pinus edulis* Engelm. was present in both the Colorado National Monument and Black Canyon National Monument. Mortality was not seen in the areas examined.

The rapid development of residential construction along the Front Range in Colorado has stimulated a great deal of interest from property owners on what

F-522811

Figure 18.–Lodgepole pine with numerous brooms, caused by dwarf mistletoe, in a heavily used campground. Several dead trees pose an immediate hazard to a developed campsite (Shoshone National Forest, Wyo.).

they can do about the dwarf mistletoe in their pine trees. The southwestern dwarf mistletoe, *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens. on ponderosa pine is very common and causing a great deal of damage and mortality wherever its development is not hindered. Homeowners were advised about the problem and given information on treating their trees. The mountain pine beetle also occurs in some of the same areas, making for an even more difficult problem.

Dutch elm disease, *Ceratocystia ulmi* (Buism.) C. Mor. The disease continues to spread into previously unreported areas in South Dakota, Nebraska, and Colorado. In Nebraska, the disease was found in Sheridan and Dawes Counties, bringing the total to 86 out of the 93 counties in the State that now report the disease. Heavy losses of American elms occurred in the Indian Caves State Park in the southeastern part of the State. Considerable mortality also occurred throughout the native elm populations in the eastern counties. In South Dakota new reports of the disease came from 11

counties bringing the known total to 37 out of 67 counties in the State. Most of the new discoveries were in the northeastern part of the State. The heaviest losses are occurring in the native elm populations, and in communities where a strong sanitation program is lacking.

In Colorado the disease was discovered for the first time in 39 municipalities in 4 counties, extending the known occurrence to 18 out of 63 counties in the State. In Kansas the disease has spread throughout the significant portions of the planted and natural elm population in the State. In Wyoming the disease has been reported only from the city of Cheyenne.

Rusts. A long-range study to determine the fate of *Cronartium comandrae* Pk. infections on young lodgepole pine was established in the Wind River Ranger District of the Shoshone National Forest. A total of 102 branch and stem infections on 83 trees showing different degrees of activity were selected for study. All except one of the infections occurred within 3 feet of the ground, which is similar to the distribution pattern of *C. ribicola* infections on eastern and western white pine. One of the stem cankers used in the study was heavily infected with the hyperparasite *Tuberculina maxima* Rostr. None of the many other cankers seen in the stand showed any evidence of *T. maxima.*

The frequent occurrence of stem galls caused by western gall rust *Peridermium harknessii* Moore and *C. comandrae* cankers was observed while evaluating a campground in the Shoshone National Forest. Approximately 22 percent of the trees were infected with rust. Many of the Comandra blister rust infections had girdled the stem in the upper part of the crown, resulting in spiked top trees. The stem galls were old infections that had deformed the stem. The galls did not appear to adversely affect the structural strength of the stem.

A detection survey for white pine blister rust *Cronartium ribicola* Fisch. on limber pine revealed the disease was well established and intensifying near the southern end of the Laramie Mountains in southeastern Wyoming. The damage was restricted to occasional branch flagging. A new infection center was detected in the southern Big Horn Mountains about 25 miles north of an infection center discovered in 1969.

Foliage diseases. General observations on needle casts of conifers in Colorado showed a low level of incidence. In contrast, near Manhattan, Kans., brown spot needle blight of Scotch pine caused by *Scirrhia acicola* (Dearn.) Siggers, showed the heaviest damage since it was first evaluated in 1970. In a systematic survey of 62 Christmas tree plantings in 31 counties in Nebraska, Dr. Charles Maier of Wayne State College found *Dothistroma pini* Hulb., on Austrian and ponderosa pine as the most prevalent needle cast fungus. The disease was present in 21 plantings or about 34 percent of those surveyed. Other less prevalent foliage diseases found during the survey were *Lecanosticta acicola* (Thuem.) Syd., *Diplodia pinea* (Desm.) Kickx., and *Phomopsis juniperovora* Hahn.

The common foliage diseases of aspen in Colorado were noticeably inconspicuous in 1973. One small pocket of aspen covering about 10 acres in the San Juan National Forest was infected with inkspot caused by *Ciborinia whetzelii* (Seav.) Seav. The disease was causing moderate to severe damage on the understory trees while the overstory trees showed only very light amounts of infection. In many locations in eastern Nebraska and Kansas, American sycamore trees were severly defoliated by anthracnose caused by *Gnomonia platani* Kleb. Additional reports from these same States and the State of South Dakota indicated the common occurrence of leaf blister disease caused by *Taphrina* sp. on elm, maple, and oak.

Noninfectious diseases. Several reports and evaluations were made concerning weather-caused or climatic diseases. In the San Juan National Forest in Colorado and in northwestern and southcentral Kansas, ponderosa pine showed damage to the needles that was diagnosed as scorch. The damage, although localized in Colorado, was quite common on planted ponderosa pine in many areas in western Kansas. Similar damage on Gambel oak and aspen in Colorado, and on cottonwood and aspen in the Black Hills National Forest in South Dakota was diagnosed as leaf scorch. In eastern South Dakota leaf scorch damage was widespread on green ash where some tree mortality is expected. Winter drying or redbelt was common on pinyon pine in southern Colorado. Localized pockets of winter drying were seen on mature lodgepole pine and lodgepole pine regeneration in northern Colorado. Frost injury on aspen was widespread in northern Colorado which probably contributed to the low incidence of infectious foliage diseases.

Miscellaneous. Evaluation surveys of 16 campgrounds located in predominantly aspen type in Colorado were made to determine the cause for and degree of tree deterioration and mortality. The surveys conducted cooperatively by Region 2 and Rocky Mountain Forest, and Range Experiment Station personnel consisted of a 10 percent sample of the campsites. The greatest amount of tree mortality was caused by *Cenangium singulare* (Rehm.) Davids. & Cash. Aspen trees in developed recreation areas are often wounded by people using the site. These wounds frequently become infection courts for *C. singulare* and other canker causing fungi. Earlier studies by research station personnel showed rapid deterioration and tree mortality in developed sites subjected to heavy use and abuse. Corrective measures involve underplanting or releasing coniferous species and avoiding aspen types in the selection of new recreational sites.

Another canker disease, *Botryodiplodia hypodermia* (Sacc.) Petr. & Syd., caused extensive damage to Siberian elm in South Dakota (fig. 19). A survey of shelterbelts in 11 counties in 1971 showed a high incidence of Siberian elm canker, particularly on 8-year-old trees in the eastern half of the State. One symptom of the disease is oozing of the sap from bark lesions which is readily detected in early spring before the trees leaf out. The cankers frequently cause partial top-kill and can result in tree mortality.

F-522812

Figure 19.–Canker of Siberian elm, showing sap oozing from the bark and necrosis of the inner bark (South Dakota).

SOUTHWESTERN STATES (R-3)[7]

by

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Conditions in Brief

Bark beetles remained the greatest insect problem in the ponderosa pine, Douglas-fir, and Engelmann spruce forests throughout the Region during 1973. Defoliating insects continued to be active in mixed conifer and aspen stands.

Douglas fir beetle caused tree mortality at Grand Canyon National Park and at other scattered locations in Arizona. The spruce beetle declined to an endemic level throughout the Region. A roundheaded pine beetle epidemic persisted on the Lincoln National Forest and Mescalero-Apache Indian Reservation in south central New Mexico. Mountain pine beetle activity increased significantly on the Kaibab National Forest in northern Arizona and the Carson National Forest in northern New Mexico.

Defoliating insects were abundant in many areas. The large aspen tortrix caused defoliation on National Forest and Park Service lands on the Kaibab Plateau in northern Arizona. The western spruce budworm increased in the mixed conifer forests of northern Arizona and northern New Mexico. At all other locations in the Region, budworm populations were low. An outbreak of western tent caterpillar continued in the Carson National Forest in northern New Mexico. White-fir needle miner defoliation caused top-kill and tree mortality on the Apache National Forest, near Alpine, Ariz. The Douglas fir tussock moth continued to damage ornamental blue spruce and white fir in Los Alamos and Santa Fe, N. Mex. Southwestern pine tip moth remained a problem in ponderosa pine planations in central Arizona. Needle miners damaged ponderosa pine in central Arizona and pinyon pine in northern New Mexico.

The most important disease agents in 1973 were the dwarf mistletoes. These parasites continued to cause serious growth and mortality losses. The first large-scale survey of western spruce dwarf mistletoe was carried out on the Fort Apache Indian Reservation, Ariz. An economic study of dwarf mistletoe control practices in the Southwest is in progress. Other disease problems in 1973 included air pollution and aspen cankers. A Regional survey of forests for air pollution injury continued. Symptoms of sulfur dioxide injury were observed at two locations in Arizona. Aspen cankers have killed a large number of trees in three campgrounds on the Carson National Forest, N. Mex.

[7]Includes all forested lands in Arizona and New Mexico, and National Park Service land in western Texas.

Status of Insects

Douglas fir beetle, *Dendroctonus pseudotsugae* Hopk. This beetle remained active in several northern Arizona locations. Prompt salvage logging in 2,000 acres of Douglas-fir blowdown helped avert an outbreak on the Kaibab National Forest, Ariz. Beetle populations on the Forest are now at low levels and should remain static. Moderate damage occurred on about 600 acres of the North Rim of Grand Canyon National Park.

Small areas of beetle-infested Douglas-fir trees were observed at other Arizona localities: below the Mogollon Rim near Payson; in the White Mountains on the Fort Apache Indian Reservation; on the Apache National Forest; and at Walnut Canyon National Monument.

In New Mexico, Douglas fir beetle damage was confined to scattered pockets in the Chuska Mountains of the Navajo Indian Reservation and the Mogollon Mountains of the Gila National Forest.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Populations are at endemic levels throughout the Region. The recent 4-year epidemic on 50,000 acres of the Fort Apache Indian Reservation, Ariz., has declined to the point where little additional spruce mortality is expected. An impact evaluation of resource losses, created by this epidemic, is in progress.

Spruce beetle activity presently is confined to blowdown and logging slash at all other locations in Arizona and New Mexico. These areas are under surveillance to insure early detection of any potentially damaging populations.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. An infestation of this insect covered 2,500 acres on the Kaibab National Forest, near Jacob Lake, Ariz. An estimated 1,000 mature ponderosa pines were killed in 1972, and many newly attacked trees were found this year. A presuppression survey is underway to mark the newly infested trees for logging. Successful containment of this potentially severe outbreak is anticipated in 1974.

Another infestation of the mountain pine beetle was detected on 1,200 acres of ponderosa pine on the Carson National Forest, south of Taos, N. Mex. Groups of sawtimber-sized trees, scattered throughout dense sapling stands, have been killed.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. This insect remained a problem on 150,000 acres of ponderosa pine type on the Lincoln National Forest and the Mescalero-Apache Indian Reservation, in south central New Mexico.

Ips beetles, *Ips* spp. Two species, *Ips lecontei* Sw., in south central Arizona, and *Ips pini* (Say), in other areas, continued to be a problem in ponderosa pine forests. Continuous forest disturbances were responsible for maintaining potentially epidemic populations in many areas. Two suppression projects on the Coconino National Forest, Ariz., successfully reduced ips populations

in ponderosa pine pole stands. Top-killing of mature ponderosa pine also was evident in many areas of Arizona and New Mexico.

Large aspen tortrix, *Choristoneura conflictana* (Wlk.). Epidemic populations of this pest were found throughout aspen stands on the North Rim of Grand Canyon National Park and the adjacent Kaibab National Forest in northern Arizona. The very heavy aspen defoliation, expected in 1974, is likely to affect esthetic values along Grand Canyon Highway.

Western spruce budworm, *Choristoneura occidentalis* Free. Populations were endemic to light throughout most of the Region. Populations show increasing trends on State and private lands east of Eagle Nest in northern New Mexico, and the Kaibab National Forest and Grand Canyon National Park in northern Arizona. In these areas, light to moderate defoliation is expected on 65,000 acres in 1974.

Western tent caterpillar, *Malacosoma californicum* (Pack.). An infestation of this insect remained active on 8,000 acres of aspen in northern New Mexico. Defoliation was again heavy on private land in 1973, but decreased on the Carson National Forest (fig. 20). Repeated heavy defoliation since 1971 has caused scattered tree and branch mortality.

F-522813

Figure 20.–Aspen defoliation by western tent caterpillar, *Malacosoma californicum*, in Rio Arriba County, Tres Piedras Ranger District, Carson National Forest, N. Mex.

White-fir needle miner, *Epinotia meritana* Hein. For the second successive year, this insect has defoliated white fir on an estimated 10,000 acres of the Apache National Forest, near Alpine, Ariz., (fig. 21). Data from permanent plots indicated defoliation has caused top-kill and tree mortality within the infested area.

Pinyon needle scale, *Matsucoccus acalyptus* Herb. This insect continued to be a problem throughout the Region where the pinyon type occurs in urban and recreation areas. Scale damage, characterized by yellowing foliage, reduced needle length and premature needle loss, primarily affects esthetic values. Trees may be killed by repeated scale feeding.

A cooperative study between the Region and the Rocky Mountain Forest and Range Experiment Station tested a cultural procedure for suppressing this pest. Eggs were washed from host trees with a garden hose. Dislodged eggs, litter, and debris were raked, bagged, and destroyed. The procedure is simple, inexpensive, and offers an effective cultural control alternative to chemical pesticides.

F-522814

Figure 21.–Defoliation by white-fir needle miner, ***Epinotia meritana.*** **Apache County, Alpine Ranger District, Apache National Forest, Ariz.**

Other insects. Several *Dendroctonus* spp. showed increased activity. The western pine beetle, *Dendroctonus brevicomis* LeC., was found attacking ponderosa pines in the Prescott, Ariz., area. Chihuahua pine mortality from the southern pine beetle, *D. frontalis* Zimm., was observed in the Santa Catalina Mountains north of Tucson, Ariz., and in other southern Arizona mountains. *D. valens* LeC., the red turpentine beetle, killed ponderosa pines at scattered localities in the central Arizona mountains.

The Douglas fir tussock moth, *Orgyia pseudotsugata* McD., continued to damage ornamental blue spruce and white fir trees in Los Alamos and Santa Fe, N. Mex., but remained endemic elsewhere in the Region. Damage from needle-mining moths, *Coleotechnites* spp., was noticeable on ponderosa pine trees near McNary and Show Low, Ariz., and on pinyon pines near Aztec and Tres Piedras, N. Mex. Pinyon pine is a new host record for this genus, and the moth causing the damage is an undescribed species. Southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar), populations caused moderate damage, but remained static on 100,000 acres of the Sitgraves National Forest, Ariz. The tiger moth, *Halisidota ingens* Hy Edws., was abundant in the Gallinas Mountains of central New Mexico, but caused only light damage to scattered ponderosa pines. Prescott scale, *Matsucoccus vexillorum* Morr., remained active on ponderosa pine regeneration in New Mexico. It was found on the Lincoln National Forest, apparently for the first time. This extends the known range of this pest into southern New Mexico.

Status of Diseases

Dwarf mistletoes, *Arceuthobium* spp. Dwarf mistletoes are the most destructive disease-causing agents in the forest of the Southwest. Nine dwarf mistletoes occur in the Region. Of these, Southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens, on ponderosa and Apache pines, is the most important. Annual losses caused by *A. vaginatum* subsp. *cryptopodum* may exceed 150 million board feet. Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., on Douglas-fir, is next in importance. The other seven dwarf mistletoes in the Region are only of local importance.

One of the locally important species is western spruce dwarf mistletoe, *A. microcarpum* (Engelm.) Hawks. and Wiens. In 1973, the incidence of this dwarf mistletoe was recorded during a spruce beetle survey on the Fort Apache Indian Reservation, Ariz. It occurred on 4 percent of 2,200 plots taken over 20,000 acres of Engelmann spruce.

In 1973, dwarf mistletoe preventive measures received increased emphasis in the management of timber stands. These measures, which were applied on 50,000 acres during the year, included removal of residual infected trees from regeneration areas and harvest of poor-risk, infected trees.

An economic evaluation of dwarf mistletoe control practices in ponderosa pine is being conducted in cooperation with the Rocky Mountain Forest and Range Experiment Station. The study will be completed in early 1974.

Air pollution. Surveys for air pollution injury to forest vegetation continued in 1973. In Arizona, symptoms of sulfur dioxide injury were observed for the second successive year at one location on the Apache National Forest and at a second location on the Tonto National Forest. The injury was confined to deciduous trees and understory vegetation. No tree mortality has been observed in the affected areas. In anticipation of possible increased emissions from a source near Holbrook, Ariz., the vegetation at Petrified Forest National Park was surveyed for air pollution injury.

A cooperative effort began at the University of Arizona in 1972 to study the relative susceptibility of several native tree species to sulfur dioxide injury. The study will be completed in 1975.

Aspen cankers. Canker diseases have killed a large number of aspen in three campgrounds on the Carson National Forest, N. Mex. A survey, conducted in cooperation with the Rocky Mountain Forest and Range Experiment Station, indicated that Cenangium canker, *Cenangium singulare* (Rehm.) Davidson and Cash, was the most serious disease in the campgrounds. This disease was frequently found near picnic tables in trees that had been wounded with axes or knives. Other canker diseases present in the campgrounds included Hypoxylon canker, *Hypoxylon mammatum* (Wahl.) Miller, and Cytospora canker, *Cytospora chrysosperma* (Pers.) Fr.

Rusts. Limb rust, *Peridermium filamentosum* Pk., continued to cause some mortality in ponderosa pine. Spruce broom rust, *Chrysomyxa arctostaphyli* Diet., and fir broom rust, *Melampsorella caryophyllacearum* Schroet., are important in several recreation areas where they are associated with bole deformation, spiketop, and mortality. Land managers are encouraged to reduce losses by removing poor-risk trees during normal intermediate cuttings.

Needle cast. Needle cast of ponderosa pine was at an endemic level in 1973. The three needle cast fungi, which have been associated with widespread damage in the past, are *Elytroderma deformans* (Weir) Dark., *Davisomycella ponderosae* (Staley) Dublin, and *Lophodermella cerina* (Dark.) Dark.

SOUTHERN AND SOUTHEASTERN STATES (R-8)[8]

by

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Conditions in Brief

The southern pine beetle continued as the major southern forest insect pest. In 1973, the outbreak expanded to include 74,000 square miles with 47 million acres of commercial pine forest. More than 300 counties in 10 Southern States from southeast Texas to central Virginia were involved. During the first 11 months of 1973, 250 million board feet (MBF) of infested sawtimber and 42 million cubic feet of pulpwood were removed. The outbreak showed no evidence of decline.

In general, defoliator activity throughout the Southeast decreased somewhat below 1972 levels. The gypsy moth, however, made a dramatic plunge into the South. Traps in 30 Virginia counties collected 754 male moths. The Outer Banks of North Carolina may be infested. An egg mass and a pupal case were found in a residential area near Winston-Salem, N.C.

The pine seed and cone insect complex came to prominence in 1973. More was learned about insect impact on seed production. Insect attacks on cone crops were recognized as the most important problem facing tree improvement programs in the South.

A rapid standardized operational method for screening slash and loblolly pine for resistance to fusiform rust were developed. This method will be used to screen 600 seed lots in 1974. The newly developed method will offer tree improvement foresters and geneticists 6-month service in testing slash and loblolly families for fusiform rust resistance. This is a considerable improvement in time over the 5 to 10 years required by field progeny tests. Thirty to forty percent differences between resistant and susceptible families are not uncommon. The Southwide rust incidence survey was completed in Alabama, Arkansas, Georgia, Florida, Louisiana, Mississippi, North Carolina, and South Carolina. Rust incidence was the highest in Georgia, Alabama, South Carolina, and Mississippi for both loblolly and slash pine. Louisiana showed a low incidence for loblolly and a high incidence for slash. Incidence was the lowest in Arkansas, North Carolina, and Florida when compared to these other States. Rust incidence was more severe on slash than on loblolly pines. There was a much higher rust incidence and a wider intensified distribution than was found in the last survey made 35 years ago.

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[8]Includes forested lands in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

Fourth year data from the Southwide *Fomes annosus* stump treatment pilot test indicated that borax and summer thinning are the most effective treatments for suppressing this disease. Annosus root rot started to cause localized mortality in several seed orchards in the Southeast.

Oak wilt incidence remained low in the Southeast. It now has been found in Texas, Oklahoma, Arkansas, Tennessee, Kentucky, South Carolina, North Carolina, and Virginia. In North Carolina, it was found in Kinston, Lenoir County, 200 air miles to the east of the nearest oak wilt infection on water and laurel oaks.

Cylindrocladium root rot, black root rot, and damping-off continued to be a problem in certain Southern forest tree nurseries. Damping-off and root rot were especially serious in container grown pine seedlings in Louisiana. Fungi isolated from infected seedlings included two species of *Fusaria, Pythium* and *Rhizoctonia solani.*

The mycorrhizae forming fungus *Pisolithus tinctorius* was an effective and practical biological technique for improved nursery seedling quality along with increased field survival and growth. Inoculated nursery seedling beds of 1-0 loblolly, slash, sand, Virginia, and white pines have a 150 percent increase in fresh weight and 90 percent increase in height growth in a 6-month growing period for some species.

White pine in the Beech Creek, N.C., seed orchard continued to show needle tip burn, dwarfing, and necrosis accompanied with additional tree mortality. There were 300 symptomatic trees involving 14 white pine superior tree clones. Evidence to date continued to point to atmospheric pollutants, such as sulfur dioxide and ozone, as the most probable causal agents of this damage.

Status of Insects

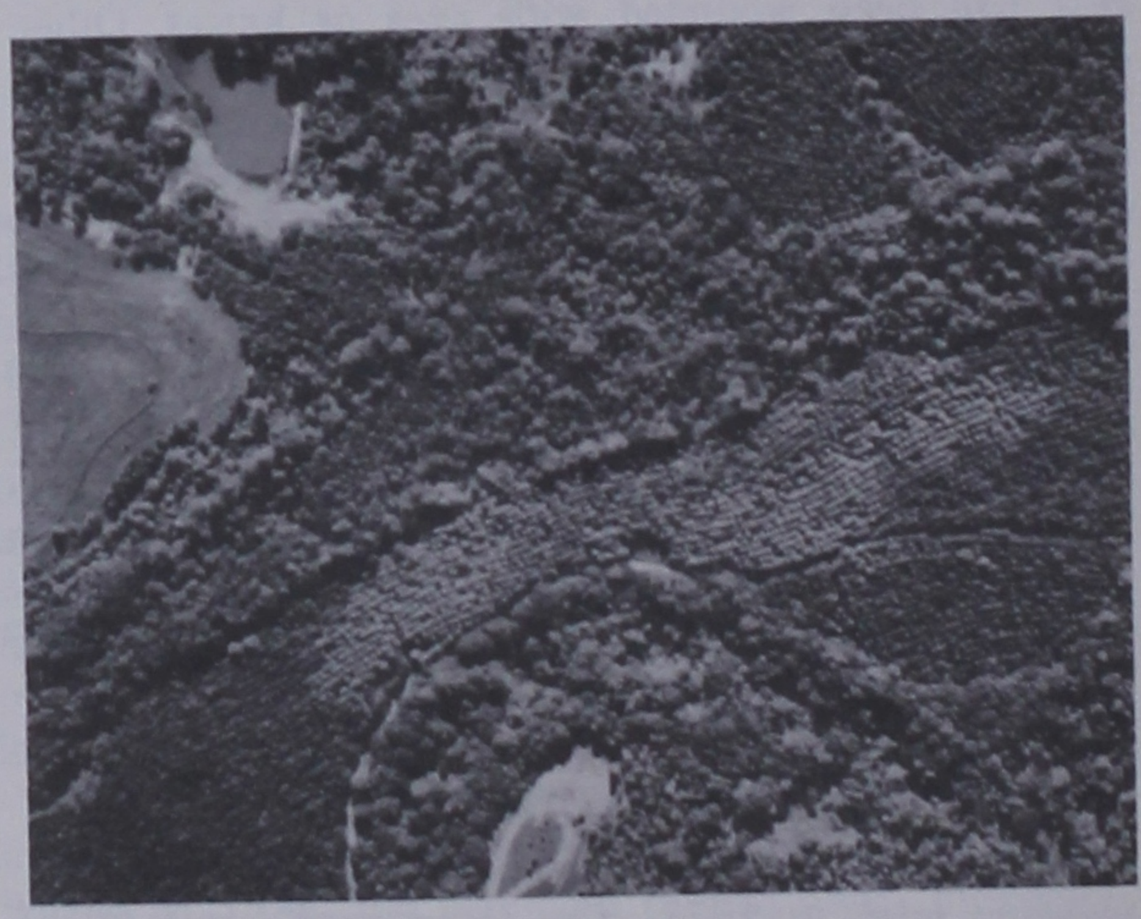
Southern pine beetle, *Dendroctonus frontalis* Zimm. The southern pine beetle outbreak in Alabama increased in both size and intensity during 1973, infesting all or portions of 53 counties. Federal lands involved in the outbreak included the Bankhead, Talladega, and Tuskegee National Forests. Combined southern pine beetle-associated timber volumes from State, private, and Federal lands totaled 45.6 million board feet of sawtimber and 18.2 million cubic feet (242,700 cords) of pulp material for the period January-October, 1973.

Southern pine beetle activity decreased somewhat in Arkansas during this same period. The infested area still included portions of four southeastern counties; however, most of the activity was concentrated in Ashley and Union Counties. Bark beetle-associated removals from State and private lands totaled more than 400,000 board feet of sawtimber and over 73,000 cubic feet (980 cords) of pulpwood during the first 10 months of 1973.

The outbreak area in Louisiana increased to 31 parishes during 1973 compared to 1972, but the intensity decreased. Volumes harvested from State, private, and Federal lands, although considerably lower than the previous year, still totaled more than 3 million board feet of sawtimber and almost 800,000 cubic feet (10,600 cords) of pulpwood for the period January-October.

Southern pine beetle activity intensified in Mississippi during 1973 to all or part of 17 counties involving 2.3 million acres of host material. Volumes removed totaled more than 2.6 million board feet and 621,300 cubic feet (8,300 cords) of material on Federal, State, and private lands. The southern pine beetle caused extensive losses in east Texas. The outbreak involved all or part of 22 counties and included more than 75 percent of the 7.6 million acres of susceptible host type. Removal volumes from all ownerships totaled more than 14.1 million board feet of sawtimber and 430,500 cubic feet (5,740 cords) of pulp material. Drastic increases in population levels occurred late in the summer on the Raven Ranger District of the Sam Houston National Forest, and on both the Neches and Trinity Ranger Districts of the Davy Crockett National Forest. The outbreak on these three districts continued at a high level–their combined monthly salvage-control figure averaging more than 1.5 million board feet since July.

In 1973 seven northeast Georgia counties, severely infested by the southern pine beetle, were declared a disaster area by the Governor (fig. 22). Fifty-nine counties with 5.6 million acres of susceptible pine host type were involved in the outbreak throughout the State. More than 53.3 million board feet of timber were harvested by the State from January through October 1973. Significant southern pine beetle infestations also



F-522815

Figure 22.–Aerial view of southern pine beetle infestation in northeastern Georgia.

occurred on the Brasstown, Toccoa, and Chestatee Ranger Districts of the Chattahoochee National Forest. On the Oconee National Forest, in central Georgia, new infestations were detected on the Redlands Ranger District. Infestations continued on the Oconee District and adjacent Hitchiti Experimental Forest and Piedmont National Wildlife Refuge. Over 7.7 million board feet of beetle-attacked timber were cut from Georgia National Forest lands from January to October of 1973.

Southern pine beetle activity increased in North Carolina during the summer and fall of 1973. Infestations were detected in 24 additional counties. By late fall, the outbreak included 64 counties with 8.4 million acres of susceptible host type; more than 51.5 million board feet were salvaged on State and private lands from January to October 1973. Southern pine beetle infestations also increased dramatically on Federal lands in western North Carolina. Spots of 1,000 trees were observed on the Wayah and Tusquitee Ranger Districts of the Nantahala National Forest and the Pisgah and Grandfather Districts of the Pisgah National Forest. Infestations continued on the Cherokee Indian Reservation and the Uwharrie National Forest.

In South Carolina, southern pine beetle infestations increased in extent and intensity during 1973. The outbreak area included 4 million acres of susceptible host type in 22 counties. Over 32 million board feet of timber were cut through the State's suppression program from January to October 1973. With the exception of the increasing infestation on the Andrew Pickens Ranger District, beetle activity decreased on the 1.4 million acres of the Francis Marion and Sumter National Forests during 1973. More than 12.1 million board feet of infested timber were harvested in control efforts on National Forest lands during the first 10 months of the year (fig. 23).

F-522816

Figure 23.–Trees predisposed to southern pine beetle attack by a tornado on the Andrew Pickens District of the Sumter National Forest.

Southern pine beetle infestations were reported in 10 counties with 690,000 acres of host type in eastern Tennessee. Beetle populations increased rapidly during the summer and fall on the Oak Ridge Reservation of the Atomic Energy Commission and the adjacent University of Tennessee Experimental Forest. Populations dropped to a low level on the Tellico Ranger District of the Cherokee National Forest. Infested trees detected on the Hiwassee Ranger District during January 1973 were removed during the winter and spring causing populations to drop; six hundred and fifty-seven million board feet of infested timber were harvested.

The State of Virginia reported that southern pine beetle infestations were relatively static at moderate levels with some local increases. Infestations occurred in 26 counties with 2.3 million acres of susceptible host type. Intensive control programs were conducted to reduce beetle populations through removal of infested trees on State forest land. More than 34.9 million board feet were harvested through control programs conducted by the State from January to October of 1973. Four hundred and twenty million board feet of infested timber were detected during a September evaluation of a 71,000-acre infestation on the Pedlar Ranger District, George Washington National Forest, the Glenwood Ranger District, Jefferson National Forest, and the James River District of the Blue Ridge Parkway. More than 6.8 million board feet of timber were removed through control efforts on the 2,700-acre Lee Experimental Forest.

Ips engraver beetle, *Ips* sp. Results of Florida's Seventeenth Statewide Forest Pest Survey indicated Ips bark beetle caused tree mortality of approximately 239,038 cords. There was an overall decrease of 5 percent in losses this year, although activity increased 38 percent in the western counties. Mortality in the 37 counties systematically surveyed averaged 16 trees per thousand acres of host type.

Ips beetles killed a large number of shortleaf pine around the shoreline of Greers Ferry Lake in Cleburne County, Ark. The trees had been weakened by a flood which did not recede until well into the summer. Engraver beetles continued to cause localized damage with some mortality to pines in Mississippi and Texas.

Black turpentine beetle, *Dendroctonus Terebrans* (Oliv.). Localized black turpentine beetle activity was found scattered throughout much of Arkansas, Louisiana, Mississippi, and Texas. Many of the attacks were associated with ornamental trees or with stressed trees around recreation areas. Spring flooding in many of the areas contributed to tree stress and subsequently increased their susceptibility to bark beetle attack.

Arkansas pine sawfly, *Neodiprion taedae linearis* Ross. The Arkansas pine sawfly caused generally light

damage in Calhoun, Ouachita, Bradley, Ashley, and Dallas Counties in Arkansas. Most trees were only lightly defoliated but some trees lost up to 25 percent of their foliage. This insect completely defoliated a half section of mixed loblolly and shortleaf pine in Lowndes County, Miss. Scattered infestations of this sawfly and the pine sawfly, *Neodiprion excitans* Rohwer, occurred over 32,000 acres in the Columbus, Miss., area. Approximately 1,000 acres located west of Tullos, La., were lightly defoliated by the Arkansas pine sawfly although less than 50 percent of the trees in the area were affected.

Pales weevil, *Hylobius pales* (Herbst) and **Pitch eating weevil,** *Pachylobius picivorus* (Germ.). Light to moderate weevil damage was found on planted loblolly seedlings on the Bankhead District, National Forests in Alabama. A survey of three potential planting areas on the Holly Springs District, National Forests in Mississippi revealed very low weevil populations (fig. 24).

Balsam woolly aphid, *Adelges piceae* (Ratz.) Infestations continued to spread throughout the Fraser fir stands of the Southern Appalachian Mountains. Thirteen of 63 trap locations along the Blue Ridge Parkway contained new infestations. Severe fir mortality is expected to occur in this area during the next 2 years.

Heavy fir mortality occurred along the scenic highway near the Heintooga Overlook in the Great Smoky Mountains National Park. No infestations were detected in the Clingman's Dome area of the park.

The North Carolina Division of Forestry completed a spray project in Mt. Mitchell State Park during 1973. Suppression measures were effective in reducing infestations in the protection zones; elsewhere in the park the aphid population continued to cause mortality.

Several new infestations were detected on Roan Mountain in the Pisgah National Forest. Suppression measures are planned in the protection zone for the spring of 1974.

Aerial and ground surveys conducted by the Asheville Forest Pest Management office found Mount Rogers National Recreation Area in Virginia free of balsam woolly aphid. This is the only uninfested area of fir in the Southeast.

F-522817

Figure 24.–Dipping seedlings in one of the pesticides used in the cooperative test to find a control agent for pales weevil control.

Fall webworm, *Hyphantria cunea* (Drury). The fall webworm was partially responsible for the extensive defoliation of pecan orchards in southeast Texas. Heavy feeding also occurred on pecan and walnut trees in Conway and Pope Counties in Arkansas. Fall webworms caused defoliation and unsightly webs at the Chalmette Battlefield, La.; the Lyndon B. Johnson Birthplace, Tex.; and the Horseshoe Bend National Military Park, Ala.

Walnut caterpillar, *Datana intequerrima* (G. and R.). The insect and the fall webworm caused the total defoliation of pecan trees in most of the orchards in southeast Texas. Some trees were stripped and refoliated three times.

Variable oakleaf caterpillar, *Heterocampa manteo* (Dbldy.), **Yellow-necked caterpillar,** *Datana ministra* (Drury), and **Orange-striped oakworm,** *Anisota senatoria* (J. E. Smith). These hardwood defoliators caused widespread defoliation throughout much of Louisiana. Defoliation ranged from moderate to heavy with the heaviest feeding by the orange-striped oakworm in western Louisiana. This complex also caused scattered defoliation over eastern Texas. Little serious damage occurred.

Forest tent caterpillar, *Malacosoma disstria* Hbn. Light to moderate forest tent caterpillar activity occurred throughout Mississippi. Most of the activity, however, occurred in the urban areas. Spring defoliation in Louisiana covered 260,000 acres of water tupelo. The trees were partially to totally defoliated with the heaviest defoliation occurring in areas previously attacked. The 260,000-acre figure represents a 37 percent decrease in the affected area from 1972.

Town ant, *Atta texana* (Buckley). A few isolated infestations of the town ant were detected in Shelby, Walker, and San Augustine Counties in Texas. Little mortality occurred (fig. 25).

Walkingstick, *Diapheromera femorata* (Say). Walkingstick defoliation occurred for the sixth straight year on the Ouachita National Forest in Arkansas. The severity and extent of the defoliation are less than in previous years.

F-522818

Figure 25.–The large crater-shaped ant hills of the Texas town ant (Louisiana).

Gypsy moth, *Porthetria dispar* (L.). Gypsy moths continued to spread into the Southeast during 1973. A trap placed by the State Agriculture Department near a residential area in Winston-Salem, N.C., picked up four male moths. Further investigation in the area revealed a gypsy moth pupal case in the duff and an egg mass on a tree. A total of 40 male moths were trapped in 15 counties of North Carolina. Most of the moths were found in the Outer Banks area on the North Carolina coast.

Traps in Virginia yielded 754 male moths in 30 counties (most along the eastern shore). Except for a small infestation in Hungry Mother State Park, there are no known infestations in Virginia.

In DeKalb County, Ga., one male moth was trapped. One moth was trapped in S.C.; one in Meade County, Ky.; and two in Indian River County, Fla. Traps in Johnson and Sevier Counties in Tennessee also picked up two male moths.

Seed Orchard Insects

Coneworms, *Dioryctria* sp. The average number of second-year cones attacked by *Dioryctria* sp. at the Erambert Seed Orchard, Miss., was 5.9 percent for slash pine, 12.6 percent for loblolly pine, and 27.4 percent for longleaf pine. Rates of second-year cone attack at the Stuart Seed Orchard, La., were 1.0 percent for slash pine, 10.0 percent for loblolly pine, 18.0 percent for shortleaf pine, and 25.0 percent for longleaf pine. The Ouachita Seed Orchard, Ark., had 44.0 percent attack on the second-year shortleaf cones. No coneworm control was attempted at any of the above orchards. A seed orchard impact study was conducted during 1973 at the State Seed Orchard at DeRidder, La.; where 75-80 percent of the female flowers and conelets were destroyed in the first 6 months of development. Of the losses, more than 90 percent were caused by insects, primarily *Dioryctria* sp (figs. 26, 27).

An average of 19 percent (range 0-52 percent) of the second-year cones on 10 check trees in a loblolly pine orchard on the Francis Marion Seed Orchard were attacked and killed by *Dioryctria* sp.

Nantucket pine tip moth, *Rhyacionia frustrana* (Comstock). Despite high tip moth populations at the beginning of the season, almost complete protection of the growing tips was obtained on shortleaf and loblolly pines at the Erambert, Stuart, and Ouachita Seed Orchards by applying dimethoate sprays when the young larvae of each generation were migrating on the external portions of the shoots. A loblolly pine stand in Marshall County, Miss. was heavily infested by this insect. Heavy infestations which resulted in growth loss occurred in loblolly and shortleaf pine stands in extreme northeast Texas. Heavy attack by second generation larvae occurred over a large area near Camden, Ark.; one area involved 2,000-3,000 acres.

Damage caused by the Nantucket pine tip moth was kept to tolerable levels on the Beech Creek and Francis

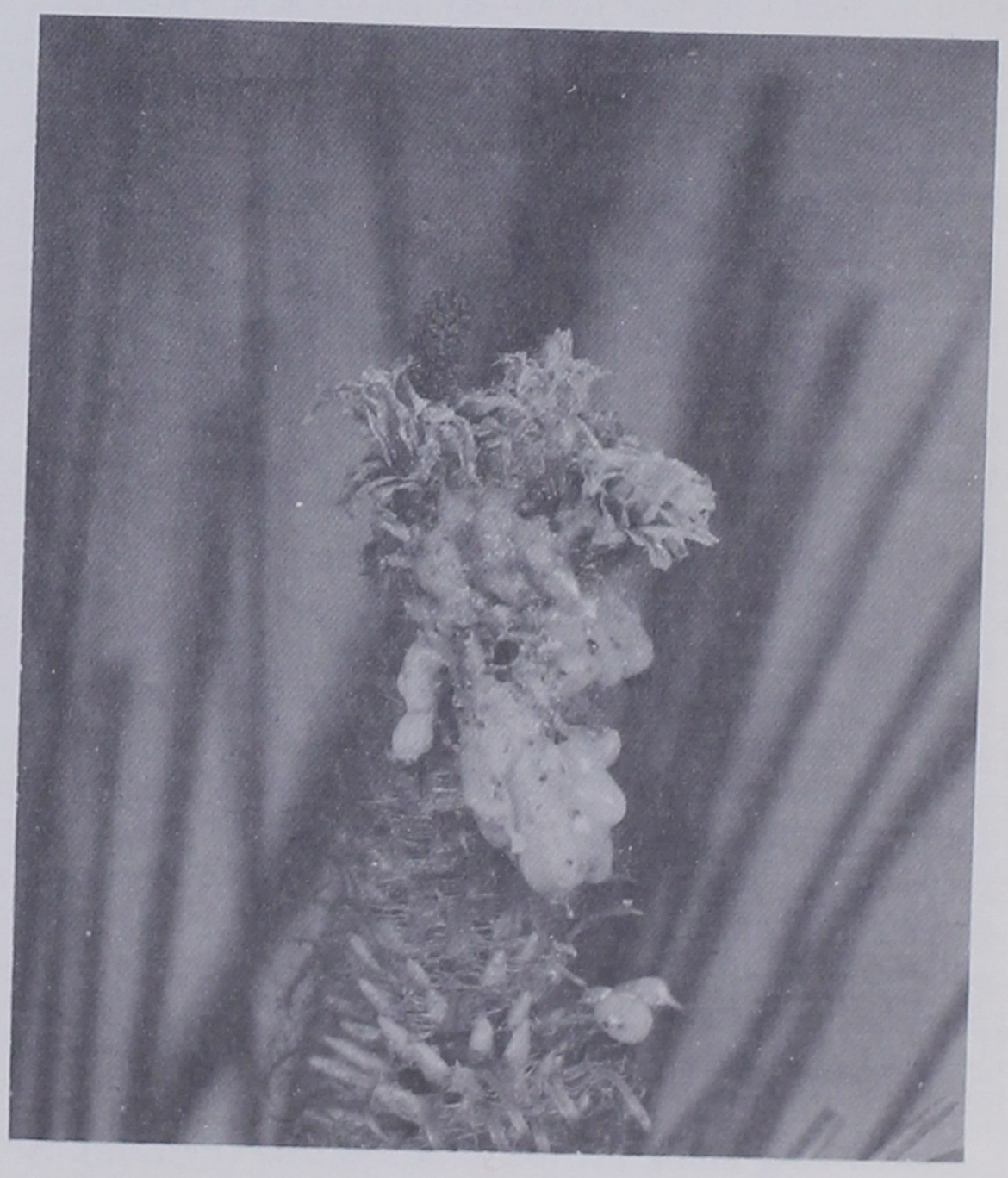


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Figure 26.–Pitch tube is evidence of a *Dioryctria* sp. shoot attack which caused death of the first-year conelet.

F-522820

Figure 27.—An adult *Dioryctria amatilla* resting on a loblolly pine cone destroyed by larval stage of this insect.

Marion Seed Orchards by timely pesticide applications. At the end of the growing season, the highest percentages of trees infested at the Beech Creek and Francis Marion Seed Orchard were 32.6 percent and 11.1 percent, respectively.

Cone moth, *Eucosma tocullionana* Heinr. A cone moth caused serious losses to cones of white pine, *Pinus strobus,* and Virginia pine, *P. virginiana,* on two seed orchards in North Carolina. More than 50 percent of the second-year cones were destroyed.

Pine tortoise scale, *Toumeyella numismaticum* (Pettit and McDaniel). An infestation of the pine tortoise scale in the Georgia shortleaf pine on the Francis Marion Seed Orchard threatened considerable damage during the 1974 growing season. A rapid buildup in the pine needle scale, *Phenacaspis pinifoliae* (Fitch), population on shortleaf pine, *P. echinata* Mill., at the Beech Creek Seed Orchard was observed during the fall months. Approximately 100 3- to 5-year-old trees were heavily infested and some mortality may result. An application of granular phorate earlier in the year had no apparent effect on the scale.

Pitch twig moth, *Petrova comstockiana* (Fernald). A relatively high population of the pitch twig moth developed in a recently transplanted pitch pine, *P. rigida,* seed orchard operated by the North Carolina Division of Forestry at Morganton, N.C. Fifty-two percent of the trees were attacked.

Miscellaneous. A heavy infestation of a coccid scale, *Toumeyella parvicornis* (Cockerell), occurred on 62 acres of shortleaf pine at the Stuart Seed Orchard, La. This scale was evidently resistant to dimethoate sprays applied for tip moth suppression. Two treatments with malathion brought the scale under control. A midge, *Contarinia* sp., continued to cause light to moderate defoliation of loblolly pines at the Erambert Orchard, Miss. An abundance of adult seed bugs, *Leptoglossus corculus* (Say), was observed on shortleaf cones and conelets at the Ouachita Seed Orchard in July. An undetermined species of tip moth, probably *Rhyacionia rigidana* (Fern.), was also found at the Ouachita Orchard, Ark.

Status of Diseases

Southern fusiform rust, *Cronartium fusiforme* (A&K) Hedge. and Hunt. A rapid standardized operational method for screening slash and loblolly pine for resistance to fusiform rust was developed by the Forest Pest Management Group. The newly developed method offers tree-improvement foresters 6-month service in the testing of families of slash and loblolly pines for fusiform rust resistance. This is a considerable improvement over the 5-10 years required by field progeny tests.

The testing method involved a complex system of procedures and equipment. Essentially the method consisted of the spray application of a quantified spore suspension on trays of greenhouse-grown, 6-week old pine seedlings. The inoculum density of the suspension was determined with an electronic particle counter. A highly automated and standardized spray apparatus was employed to insure that each seedling tested was exposed to a standardized amount of inoculum at the time of inoculation. The volume of spray emitted from the nozzles was controlled quantitatively by a system of flow meters that control the air and liquid flow through the atomizer sprayers. The exposure time of the seedlings was controlled by the speed of the conveyor belt which transports the seedlings past the spray nozzles.

Immediately after inoculation, the seedlings were placed in a large walk-in incubation chamber (12′ x 12′ x 10′) where they were exposed to standardized humidity (96 percent +) and temperature (77° F.) for 24 hours. The seedlings were then returned to the greenhouse for 3- to 6-month holding period before evaluation of the percentage infection per family. Thirty to forty percent differences between resistant and susceptible families were not uncommon.

In 1974, 600 unknown seed lots will be tested for fusiform rust resistance. The addition of 1,800 square feet of greenhouse space in early 1974 will increase the testing facility capacity threefold. With further expansion, the testing center is scheduled for full scale

operation by 1975 with a testing capacity of 2,500 seed lots per year.

The Southwide rust incidence survey was completed and the report released during 1973. These incidence surveys were cooperatively conducted by the Forest Pest Management pathologists and State forestry organizations in Alabama, Arkansas, Georgia, Florida, Louisiana, Mississippi, North Carolina, and South Carolina during the period 1971-1973. Plantations of slash and/or loblolly were sampled in the 8- to 12-year age class located at or near the intersection of grid lines that were at 10 mile east-west and north-south intervals. The ratio estimation statistical survey method was used. Maps and summary tables showing infection incidence and impact were prepared from field data.

A total of 1,319 loblolly and 1,173 slash plantations in the Southeast were surveyed. Fusiform rust incidence appeared to be the highest in Georgia, Alabama, South Carolina, and Mississippi for both loblolly and slash pine. Louisiana showed a low incidence for loblolly and a high incidence for slash. Incidence was lowest in Arkansas, North Carolina, and Florida when compared to these other States. Losses due to nonmerchantable and dead trees were the highest for loblolly in Alabama (4 percent) and slash in South Carolina (9 percent) (fig. 28). All sampled trees in both species had less than 50 percent stem cankers in all the States surveyed. The highest percentage of stem cankers was found on slash pine (41 percent) and loblolly pine (31 percent) in Georgia. Rust incidence was more severe on slash than on loblolly pines. This survey showed much higher rust incidence and a wider intensified distribution than was found in the Southwide survey made 35 years ago.

Fusiform rust spray study plots were established in eight southern nurseries during the spring of 1973. This 5-year study was conducted in cooperation with the Southeastern Forest Experiment Station with the objective of determining the efficacy of modified ferbam spray schedules for controlling the rust on loblolly and slash pine seedlings. Results obtained from similar study plots in 1972 showed a general lower rust incidence on both sprayed and nonsprayed plots as compared with previous years. However, notable exceptions were observed in nurseries in Georgia, Florida, and Louisiana where rust infection on nonsprayed slash pine was 60 percent, 50 percent, and 30 percent, respectively.

Fusiform rust galls began to appear on several longleaf pine trees at the Erambert Seed Orchard in Mississippi. Longleaf pine, which was considered more resistant to the rust than loblolly or slash pine, is not frequently infected in natural stands. The increase in susceptibility was probably the result of growing the

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Figure 28.–A slash pine plantation exhibiting typical fusiform rust damage–limbs and stems broken at the canker caused by the disease (Louisiana).

trees under seed orchard conditions of increased soil and stand manipulation. On an Alabama Weyerhaeuser Seed Orchard good control and rust galls on loblolly pine by mechanical excision was achieved by cutting a 2-inch border around the edge of the gall and removing all infected bark tissue from within the cankered area.

Annosus root rot, *Fomes annosus* (Fr.) Karst. Data on residual tree mortality collected in conjunction with the Southwide stump treatment pilot test continued to show that borax was the most effective stump treatment for preventing the entrance of *F. annosus* into slash and loblolly pine stumps. Since establishment of the pilot test 4 years ago, only three trees have become infected in the borax treated plots. Summer thinning appeared to be the next most effective treatment with four residual trees killed by the pathogen. Stumps treated with *P. gigantea* have yielded seven residual tree infections and sodium nitrite treatments have produced 17 dead or infected trees. In comparison, residual tree mortality and infection in the untreated check plots totaled 69 trees. If the present trends continued over the next few years, both borax and summer thinning will likely emerge as the most effective methods of preventing stump infection by *F. annosus*. Annosus root rot continued to occur and cause localized mortality in the Hiwassee Land Company's loblolly pine seed orchard in eastern Tennessee. Infection and mortality have now recurred for 3 successive years. Cumulative detected infection and mortality since initial detection in October 1971 were 60 and 16 trees, respectively (fig. 29).

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Figure 29.–Mortality due to annosus root rot in a slash pine plantation in Alabama.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. The incidence of oak wilt remained low in the Southeast. Cooperative State-Federal aerial surveys over 9.4 million acres of northern Louisiana, Mississippi, and Alabama failed to reveal any positive oak wilt infections. In the Southeastern Area, the disease now has been found in Texas, Oklahoma, Arkansas, Tennessee, Kentucky, South Carolina, North Carolina, and Virginia. Surveys conducted in western North Carolina and western Virginia by respective State forestry personnel showed a general disease incidence and distribution status quo in both States. However, one significant change in distribution occurred in North Carolina. Oak wilt was detected and confirmed by personnel from North Carolina Division of Forestry and North Carolina State University on shade tree water and laurel oaks (approximately 20 trees) near Kinston, Lenoir County, N.C., in the late fall of 1972. This location is approximately 200 air miles east from the nearest known oak wilt infection areas in western North Carolina. Remedial action was taken to remove and treat the infected trees to prevent additional short- and long-range spread to healthy high-value oak shade trees in the area. However, the disease distribution was not extended beyond its previously known range in the Southeast during 1973.

White pine blister rust, *Cronartium ribicola* Fischer. This rust disease continued to cause localized infection and damage to eastern white pine timber stands, Christmas tree plantings, and high-value esthetic areas in western Virginia and western North Carolina. Ribes eradication work was again conducted on the Shenandoah National Park in Virginia and in localized high-hazard rust areas in western Virginia and western North Carolina. However, rust control zones have been further described, delineated, and localized in recent years in these two States so as to represent only a fraction of the previous control acreage.

Comandra blister rust, *Cronartium comandrae* Pk. Comandra blister rust continued to cause localized severe damage to young loblolly pine plantations and shortleaf pine natural stands in eastern Tennessee and northern Arkansas, respectively. However, surveys and field observations continued to show the disease remained localized almost exclusively in these two areas. One notable exception was the spring 1972 detection of the disease in a young loblolly pine plantation in Crittenden County (western) Kentucky. However, a

1973 survey of 20 young loblolly pine plantations in seven western Kentucky counties failed to reveal any additional disease occurrence. Results obtained from a cooperative comandra rust susceptibility study established by the USDA, Forest Service, Tennessee Division of Forestry, and Unversity of Tennessee, in southeastern Tennessee, showed that four species of pine (loblolly, shortleaf, pond, and slash) were susceptible to the disease. Four additional pine species displayed no evidence of disease susceptibility after 4 years of exposure in a natural high-rust incidence area.

Cylindrocladium root rot, *Cylindrocladium scoparium* Morgan and *C. floridanum* Sobers and Seymour. Cylindrocladium root rot has caused considerably less damage in Southeastern United States forest tree nurseries in 1973 than in previous years. In fact, this year marked the lowest disease incidence and damage since 1968. Much of this observed reduction was attributed to planting site rotations (avoiding known infested sites) along with employment of more effective soil fumigation procedures. Results obtained from a 2-year-old black walnut outplanting study established in eastern North Carolina in cooperation with the North Carolina Division of Forestry suggested a correlation between severity of root rot and survival of 1-0 walnut seedlings in the field. Trees with less than 10 percent root rot had approximately 60 percent survival while trees with over 10 percent root rot had approximately 45 percent survival. Annual remeasurements will be made in this outplanting field test during the next 3 years. A similar 1-0 yellow-poplar outplanting study was established in western Tennessee in cooperation with the Tennessee Division of Forestry in 1973.

Black root rot, *Sclerotium bataticola* Taub. (Davis) and *Fusarium oxysporum* Schlect. This disease continued to be a problem in some southern nurseries. It was postulated as the primary cause of approximately 1.5 million 1-0 loblolly pine seedling mortality at the Walker State Nursery at Reidsville, Ga., during the late summer of 1973. One of the causal fungi, *F. oxysporum*, was consistently isolated from symptomatic seedling roots. Soil fumigation has not been employed at this nursery during any of the 14 years of its existence. Decisions have been made by the State nursery personnel to employ the standard preplanting soil fumigant MC-2 (methyl bromide–98 percent and chloropicrin–2 percent) at approximately 350 pounds per acre prior to establishment of the 1974 seedling crop.

Damping-off, *Fusarium solani.* This disease also continued to cause localized, severe damage in southern nurseries. Postemergence damping-off symptoms were consistently associated with the eventual mortality of approximately 80,000 1-0 black locust seedlings during the early summer of 1973 at the Morgan County State Nursery in eastern Kentucky. Preplanting soil fumigation with methyl bromide formulations were never employed at this nursery. Preplanting soil fumigation with standard Vorlex treatments accompanied with several postplanting standard captan drench treatments were ineffective in controlling the disease in 1973. Plans have been made to test several methyl bromide formulations (i.e. MC-2, MC-33) for future control of this disease as well as nematodes, other pathogenic soil fungi, and weeds at this nursery. Damping-off and root rot of container grown pine seedlings continued to be a problem in Louisiana. *Fusarium* sp. were most commonly associated with the disease. In addition *Rhizoctonia solani* and *Pythium* sp. have been detected. The seedlings were grown in greenhouses from seed and are shipped 8-10 weeks after germination. Three crops of seedlings were grown from fall to spring with crops started in October, January, and March. The disease was usually less severe in the first crop and gets successively worse with each crop. *Fusarium* often first appeared on attached seed coats of recently germinated seedlings. The fungus then colonized the cotyledons and eventually killed the seedlings. Abundant *Fusarium* sporulation was usually present on dead seedlings. Subsequent watering probably aided in spread of the fungus spores. Several species of *Fusarium* were isolated from longleaf pine seed lots. These included *F. oxysporum, F. solani, F. moniliforme, F. roseum,* and *F. tricintum*. The actual pathogenicity of these species has not yet been determined. Several fungicides were being tested for control of this disease.

White pine foliage disease. Specific causal agent(s) unknown to date. A foliage disease on 2-0 eastern white pine has been of particular concern in one North Carolina and one South Carolina State nursery. The fungus, *Pestalotia* sp., was most consistently isolated from affected pine needles. However, the majority of the literature concerning this fungus suggested it to be primarily saprophytic on affected plant parts. Pathogenicity tests were being planned using isolates of the *Pestalotia* sp. detected on 2-0 white pine foliage. Over 8 million 2-0 white pine were affected by the disease in two separate nurseries in 1973. Symptom patterns displayed at both nurseries were very similar and were initially observed in August. Extremely heavy rainfall during the normally drier summer months of July and August undoubtedly favored the disease buildup in 1973. The fungicide, Daconil (Bravo), at the dosage rate of 2 pounds per 100 gallons of water, applied once per month from May to October (supplemented by additional sprays during rainy periods) was shown to be an effective control measure.

Phytophthora root rot, caused by several *Phytophthora* sp. This disease has caused severe damage to both Fraser fir nursery seedlings and Christmas tree plantings in western North Carolina during the past few years. Several thousand nursery seedlings, as well as several hundred Christmas trees, have been killed.

Disease severity seemed to be correlated with poor internal soil drainage in both the nursery and Christmas tree plantings. Research is presently underway at North Carolina State University in an attempt to further identify and remedy additional aspects of this disease problem.

Mycorrhizae, *Pisolithus tinctorius.* This tungus has recently been shown by pathologists at the Southeastern Forest Experiment Station to be a very beneficial and effective fungal symbiont of many pine species. Following pioneer research studies conducted by the Southeastern Forest Experiment Station pathologists cooperative field studies were established in the spring of 1973 in selected nurseries in North Carolina, Georgia, and Florida to further test the effectiveness of *P. tinctorius* in improving nursery seedling quality along with increasing survival and growth in field outplantings. This was a cooperative study between the Southeastern Forest Experiment Station, the Forest Pest Management Group, State and Private Forestry, and three State Divisions of Forestry. Preliminary results obtained showed both *P. tinctorius* vegetative mycelium and basidiospores were successful in root inoculations of 1-0 nursery seedling beds of loblolly, slash, sand, Virginia, and white pines. Inoculated seedling responses based on increased fresh weight and height growth were over 150 percent and 90 percent, respectively, in some species. Therefore, results of these studies obtained indicated a good probability of the development of an effective and practical biological technique for improved nursery seedling quality along with increased field survival and growth. The outplanting phase of the study was in progress during the winter of 1973. The outplanting was designed for 5 years with annual remeasurements.

Atmospheric pollutants. Needle tipburn, dwarfing, and necrosis accompanied with significant additional mortality recurred in 1973 on eastern white pine superior tree clones at the Beech Creek Federal Seed Orchard in western North Carolina. A survey conducted during the summer of 1973 in the North Carolina seed source at the orchard revealed over 300 symptomatic trees involving 14 clones. In addition, 19 percent of the affected trees were dead. This represents a 13 percent increase over the mortality recorded in this seed source in 1972. However, initial white pine foliage symptoms were observed considerably later this year (approximately July 5) as compared with previous years (May). Both symptom incidence and severity were considerably less throughout the Southeast this year. All evidence to date continued to point to atmospheric pollutants (most likely SO_2 and/or O_3) as the most probable causal agents of this damage.

Miscellaneous diseases. Sycamore anthracnose, *Gnomonia veneta* (Sacc. and Speg.) Kleb., again caused severe defoliation and damage in the South on American sycamore. This was primarily due to the unusually wet and cool spring and summer of 1973. Near total defoliation was observed along the Mississippi Delta and in the major river bottoms of Louisiana, Arkansas, Tennessee, and Mississippi. Localized mortality occurred following 3 successive years of severe infection and tree defoliation. The coal fungus, *Ustulina vulgaris* Tul., caused extensive root and butt rot of sugarberry (*Celtis laerigata*) in residential areas of New Orleans, La. Windthrow of diseased trees from early spring storms necessitated costly removal and cleanup by the city.

Red brown butt rot, *Polyporus schweinitzii* Fr., caused a moderate amount of degradation in loblolly and shortleaf pine sawtimber located on the Big Thicket District in the Sam Houston National Forest in Texas. Entrance into the heartwood was gained primarily through basal fire scars which originated approximately 30 years ago. Data collected from 57 survey plots located in a recent sale area revealed that 19 percent of the trees were infected with *P. schweintzii* when harvested.

The root rot fungus, *Polyporus lucidus* Leys. ex. Fries, caused mortality to *Cassia* sp. (Casia), *Inga vera* (Guaba), *Cordia* sp. (manjack) *Delonix regia* (flamboyan), and *Abbizzia lebbeck* (Acacia) in Puerto Rico and the Virgin Islands. Most of these trees were roadside or ornamental in the Leguminosae family. *Fomes sweiteniae* (Mun.) Rick. caused a butt and root rot in *Bucila buceras* L. (black olive) trees. *Septobasidiun curtisu* caused a dieback and decline in Eucalyptus sp. A serious black gumosis occurred in *Eucalyptus* sp. plantations on Puerto Rico. Over 30 percent of 12- to 15-year-old trees were affected in parts of Puerto Rico. A serious butt and root rot of *Hibiscus tiliacens* L. (mahoe) occurred in plantations in the central mountains of Puerto Rico.

NORTHEASTERN STATES (R-9)[9]

by

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Conditions in Brief

Unlike most previous years, no new important outbreaks of forest insects were detected in the Northeast during 1973. However, there were continued expansions

[9] Includes forest lands in Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

of defoliator infestations. The gypsy moth spread through Pennsylvania, showed up in an unexplained place in northern Ohio, and is threatening to become established in lower Michigan. Overall, nearly 1.8 million acres were defoliated. In an effort to limit its impact, approximately 175,000 acres were aerially sprayed. Known parasites of the gypsy moths were released in Maryland, West Virginia, and Wisconsin as a measure for lessening the impact of the pest when it becomes established.

The spruce budworm is present on many of the important balsam fir producing sites in the Lake States. Salvage cutting and other stand manipulations are being done to manage these populations. In Maine about 450,000 acres, or 20 percent, of the defoliated area was treated with Zectran. Egg mass and damage surveys indicate another 430,000 will need treatment in 1974. The cherry scallop shell moth was rapidly expanding in the major cherry-producing regions of Pennsylvania. Damaging populations were also present in Maryland, Massachusetts, New York, West Virginia, and Vermont. No suppression measures were undertaken, but field tests with Gardona are anticipated for next year. In Michigan severe defoliation caused by the large population of hardwood defoliators, including the variable oakleaf caterpillar and the red-humped oakworm, decreased noticeably from 392,000 acres in 1972 to 60,000 acres in 1973. Promising insecticides were field tested. A change in weather conditions probably has been the greatest single factor in the decline of larch sawfly and the forest tent caterpillar problems in the Lake States forests, and the southern pine beetle outbreak in Delaware and Maryland.

Disease-causing organisms were mostly static and caused no great havoc; however, Dutch elm disease continued its spread through the host type stands of the Lake States. Current suppression techniques are still not suitable under forest conditions. Oak wilt has not been a problem within its wide range, except where dense oak stands where severe infections spread through root grafts. Red pine tip blight and *Scleroderris* canker, two newer Lake States disease problems, intensified in local situations but spread was minimal. Lophodermium needlecast was common in many Christmas plantings where Spanish and French varieties of Scotch pine were most severely effected. State nurseries in Pennsylvania also destroyed infected seedlings.

Anthracrose was reported from most States, largely due to a prolonged wet spring. Fortunately, the impact on forest stands is negligible. White pine blister rust is still a limiting factor in eastern white pine management; genetically resistant stock is under development in Forest Service seed orchards in Wisconsin. Millions of board feet of beech wood is being destroyed annually by the beech bark disease. It has now reached stands in the western part of New York.

Status of Insects

Gypsy moth, *Porthetria dispar* (L.). Gypsy moth infestations have exploded this year in Pennsylvania, with most of the State now considered infested. Here, gypsy moth feeding caused moderate to heavy defoliation on an estimated 857,000 acres; more than double the acreage defoliated in 1972. This upward trend in population has been occurring in the Northeast since 1968. Overall, nearly 1.8 million acres were defoliated in 1973, up 25 percent from 1972, as shown in the following tabulation:

States	*Acres defoliated*		*Acres treated*	
	1972	*1973*	*1972*	*1973*
Connecticut	513,880	333,215	–	–
Maine	40	490	–	–
Massachusetts	20,480	43,970	–	–
New Hampshire	200	30	–	–
New Jersey	226,140	254,865	47,412	47,881
New York	177,605	248,441	43,000	15,715
Pennsylvania	404,060	856,710	24,800	39,610
Rhode Island	22,150	35,925	58,968	67,773
Vermont	4,215	200	–	–
Total acreage	1,369,130	1,773,846	174,180	174,506

The pest also appeared, unexplainably, outside the quarantine area in Ohio, where a 1-acre infestation was located in Richfield, near Cleveland; and in a woodlot in Isabella County, near the central part of lower Michigan.

Control of gypsy moth has been subject to considerable controversy, since the impact of defoliation on the host, people, and environment has not been clearly measurable. Current treatment efforts are not aimed at limiting the spread and eradicating populations of the pest but rather are used to protect the benefits man derives from trees, including all forest resources, such as timber and other values, like shade; temperature, wind, and noise-level reduction; and privacy.

Approximately 175,000 acres were treated in the cooperative State-Federal program. Three registered insecticides—carbaryl, trichlorfon, and *Bacillus thuringiensis*, a biological, were used successfully. Disparlure, a male sex attractant, used as a confusing agent to reduce mating, was applied experimentally by cooperating agencies on 16,000 acres in Massachusetts. Preliminary results were promising.

In an effort to eliminate an isolated outbreak in central lower Michigan, nearly 14,000 acres were aerially sprayed with carbaryl by USDA, Animal and Plant Health Inspection Service. Followup surveys are underway to determine the extent and severity of this outbreak.

To detect expanding populations, States surrounding and adjacent to Pennsylvania continue to monitor the influx of gypsy moth, using the disparlure-baited traps. This year new male catches were recorded in the northeastern area in two counties in Illinois, one in Ohio, and 17 in West Virginia. In central lower Michigan, moths were trapped in 18 counties surrounding the three counties where successful trapping occurred in 1972.

Pennsylvania continued to rear and release gypsy moth parasites in 1973. Of 17,449 parasites released, *Brachymeria intermedia* comprised 55 percent of the total. West Virginia released 19,081 *B. intermedia* in areas where the fall cankerworm, saddled prominent, cherry scallop shell moth, and orange-humped maple-worm could serve as alternate hosts. Establishment of the parasite may lessen the impact of the impending invasion of the gypsy moth into the State. Maryland and Wisconsin also reported release of parasites.

Populations are expected to vary within States next year with a considerable increase in Massachusetts, and a general spread south and west of the currently infestated area. Nearly 375,000 acres are tentatively scheduled for treatment by States in 1974.

Spruce budworm, *Choristoneura fumiferana* (Clemens). The spruce budworm in northern Maine covered about 2,500,000 acres; all in Aroostook, Penobscot, and Washington Counties. In Washington County and on offshore islands, tremendous flights of spruce budworm moths were observed in July. Gravid female moths were depositing large numbers of egg masses on building surfaces. In general, egg mass counts were extremely high in untreated areas.

In June, a Federal-State-private suppression project on 450,000 acres of State and private woodlands were sprayed with Zectran at a rate of 0.15 lbs./gal./acre. Results indicated substantial foliage protection. Larval population was reduced over 90 percent in treated areas. Egg mass and damage surveys indicate 430,000 acres need treatment in 1974.

In the Lake States, damaging populations of spruce budworm are still present on about 500,000 acres in northeastern Minnesota, on 15,000 acres in northeastern Wisconsin, and are scattered in upper Michigan. Little expansion of outbreak boundaries occurred this season. Chemical suppression has been absent for several years since control efforts by States and National Forests are moving in the direction of stand manipulation and utilization. Improvement in wood market has helped this situation. Increased defoliation is anticipated for northern Wisconsin in 1974.

Jack-pine budworm, *Choristoneura pinus* Freeman. Budworm larval counts in northwestern Wisconsin were the lowest in several years and little defoliation was noted throughout the jack pine type. Larval and pupal parasitism were evident and further reduced populations. Egg counts were generally low and no severe defoliation is anticipated anywhere in the State in 1974.

In Michigan, about 1,000 acres of light defoliation was noted on the Upper Penninsula; populations on the Huron-Manistee National Forest were on the increase. Only low levels of population were present in Minnesota jack pine stands. No change is expected in 1974.

Cherry scallop shell moth, *Hydria prunivorata* (Ferguson). Larval populations caused extensive defoliation of black cherry in Pennsylvania for the third consecutive year. The 1972 infestation doubled in size with heavy defoliation on 130,000 acres and light to moderate defoliation on 213,000 acres.

In New York, approximately 10,000 acres were defoliated, compared to 250,000 acres in 1972. Maryland reported light to moderate defoliation on 100 acres and West Virginia indicated scattered defoliation on 500 acres. Massachusetts and Vermont populations were down from last year.

The USDA Forest Service Insecticide Evaluation Project at Berkeley, Calif., conducted a screening test for an effective chemical to control this pest. Preliminary results indicate Gardona is the most practical effective insecticide. Malathion was nontoxic at the highest dosage level.

Saratoga spittlebug, *Aphrophora saratogensis* (Fitch). Damage by and populations of this insect were much higher in 1973 than 1972 in eastern Maine. Approximately 4,000 acres of red pine plantations were infested; 2,000 acres were treated with malathion. There was a continued decrease in damage by this insect in the Lake States.

Red-humped oakworm, *Symmerista canicosta* Franclemont. Approximately 42,000 acres of white oak were moderately to severely defoliated by this insect in eastern Connecticut. Population levels are also high in southern Rhode Island, where a serious problem is expected next year.

After 3 years of increasing population in a hardwood defoliator complex the red-humped oakworm is diminishing on the Huron-Manistee National Forest in Michigan. Approximately 60,000 acres showed severe defoliation in 1973; noticeably less than last year's 400,000

acres. A small field test of three pesticides indicated carbaryl was the most effective in reducing the larval population.

Variable oak leaf caterpillar, *Heterocampa manteo* (Doubleday). Defoliation of oak and other hardwoods by this caterpillar in association with the red-humped oakworm and yellow-necked caterpillar was reported from many locations in west central and northwest Wisconsin. The largest single area of infestation was reported on 6,000 acres of scrub oak. *H. manteo* is beginning to dominate the defoliator complex in lower Michigan.

Larch sawfly, *Pristiphora erichsonii* (Hartig). Nearly every stand of larch growing in the northern half of New Jersey was severely defoliated (60-100 percent) by the larch sawfly. About 5,200 acres of larch was defoliated in New York, with the overall population stable. On poor sites, larch mortality is occurring after 5 consecutive years of defoliation. The population is severe in north central Wisconsin. Flooding of bogs may have reduced the presence of this pest in Minnesota. Upper Michigan reported low populations and no observable damage. No suppression was undertaken.

Oak leaf roller and tiers, *Croesia albicomana* (Clemens) and *Archips argyrospilus* (Walker). Increasing populations of the leaf rollers on trees in the red oak group was observed in three central New Jersey counties. In Rhode Island, there was a decline in the population after relatively higher levels since 1969.

Noticeable defoliation in Pennsylvania is down to about 113,000 acres, while southeastern West Virginia showed about 200,000 acres with feeding damage. In east central Wisconsin, a severe population has contributed to dieback and mortality on 4,500 acres of red oak and 8,000 acres of pin oak. Intermediate and suppressed trees were most susceptible.

White pine weevil, *Pissodes strobi* (Peck). Surveys for white pine weevil indicated populations increased in northwestern Wisconsin, especially in young jack pine stands. Damage also appears to be greater than in recent years in west central counties where an estimated 5 percent of the tops were weeviled in some areas of jack pine reproduction, and up to 20 percent top-killing occurred in some white pine and Norway spruce plantations. The pest is becoming major in Rhode Island; population levels and damage incidence are on a downward trend for the third consecutive year in New Hampshire.

Large aspen tortrix, *Choristoneura conflictana* (Walker). Damage by this insect was present throughout the Upper Peninsula of Michigan, northern Wisconsin, northeastern Minnesota, and northwestern Maine; almost everywhere the host occurred. Moths were so numerous in some locations, they covered exterior walls of buildings and were several inches deep beneath street lights. In general, defoliation ranged from light to moderate. However, scattered small areas of heavy defoliation occurred. No measurable effects of defoliation have been determined. High populations are expected next year.

Fall cankerworm, *Alsophila pometaria* (Harris). Moderate to heavy defoliation on 10,000 acres in 1973 was reported by Pennsylvania, while West Virginia reported 2,200 acres of heavy to complete defoliation. A large area in Elk Neck State Forest, Md., was reported infested and parasite release work has been conducted in this area. The population is declining in Rhode Island. In New Jersey, carbaryl was used to effectively treat 365 acres.

Hemlock looper, *Lambdina athasaria athasaria* (Walker). Approximately 2,500 acres of hemlock was defoliated in Essex, in the northeastern part of Massachusetts. Damage appeared to be confined to mature stands. Control measures were undertaken by private landowners, using malathion at a rate of 1 pound/acre. The population has declined considerably in southeastern Massachusetts and Rhode Island. Increased activity by the hemlock looper in western Pennsylvania caused moderate to heavy defoliation on 5,200 acres.

Fall webworm, *Hyphantria cunea* (Drury). This unsightly pest is reported increasing in the States of Missouri, Pennsylvania, and West Virginia. Pennsylvania reported the heaviest infestations occurring in the southwestern portion of the State. West Virginia reported complete defoliation on 500 acres and Missouri is predicting scattered moderate to heavy defoliation on a Statewide basis in 1974. Ohio reported a decrease in population level from 1972. Ornamental and shade trees were defoliated in the New England States. Potential outlook for next year is continued high population.

Forest tent caterpillar, *Malacosoma disstria* Hubner. The forest tent caterpillar population collapsed in Pennsylvania in most areas, however, maple mortality is evident on 2,800 acres previously infested by this pest. A low level population exists in Minnesota. Surveys reveal about one egg mass for 10 trees. Weather extremes during the early larval stages are suspect when population varies.

Bark beetles. Bark beetles were active in balsam fir which was severely defoliated by spruce budworm in northeastern Wisconsin. Bark beetles also attacked weakened coniferous trees in low-lying areas in west central Wisconsin which had been flooded during April, May, and June. Some buildup also occurred following a 5-week-long dry period in July and August.

Pine Looper, *Lambdina athasaria pellucidaris* (G. & R.). On Cape Code, and vicinity, several thousand acres of pitch pine were visibly defoliated by this insect. At Otis Air Force Base, Mass., the U.S. Air Force treated 13,000 acres of pitch pine with malathion. Local towns aerially treated several thousand acres with carbaryl. Results of the spray operations indicate good control.

Red pine scale, *Matsucoccus resinosae* (Bean and Godwin). Although no new outbreaks of red pine scale were found this year, control work continued on existing infestations in the Wanaque Reservoir, Passaic County and Bergen County, New Jersey. In New York, the red pine scale infestation has increased considerably over last year and was detected for the first time in Rockland County. Much of the red pine in the vicinity of Long Island and extreme southeastern part of New York are now infested.

Miscellaneous Insects

Balsam woolly aphid, *Adelges piceae* (Ratz.), caused tree mortality in coastal regions of Maine and on 13,000 acres in northern Vermont. Oak ridgetop sites in Union County, Pa., were heavily infested with the pit-making oak scale, *Asterolecanium variolosum* (Ratz.). The orange-striped oakworm, *Anisota senatoria* (J. E. Smith), is increasing in Rhode Island after 6 years at a low level. In Pennsylvania about 30,000 acres were defoliated by the green-striped mapleworm, *Anisota rubicunda* (F.); with scattered defoliation reported throughout West Virginia. Next year's outlook for the fall webworm, *Hypantria cunea* (Drury), is continued high populations in Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. The satin moth, *Stilpnotia salicis* (L.), was moderate to severe on about 6,000 acres in north central Maine where heavy defoliation occurred in the late 1960's. Eastern tent caterpillar, *Malacosoma americanum* (F.), populations collapsed in Pennsylvania and West Virginia while light defoliation was noted throughout southern Missouri. Sugar maple defoliation caused by the Bruce spanworm, *Operophtera bruceata* (Hulst), was again common and widespread in northern Maine; an increasing population was noted in central Vermont. In northern Vermont larvae of the linden looper, *Erannis tiliaria* Harr., defoliated approximately 150,000 acres of hardwoods. Bagworm, *Thyridopteryx ephemeraeformis* (Haw.) continues to cause damage to conifers in Illinois, Missouri, Ohio, and West Virginia.

Surveys in Vermont for the maple leaf cutter, *Paraclemensia acerifoliella* (Fitch), indicated defoliation on 50,850 acres of sugar maple; heavy feeding also occurred in western counties of New Hampshire. Attempts of Christmas tree growers to control severe infestations of the balsam gall midge, *Dasinuera balsamicola* (Lint.), in young plantings in Wisconsin produced poor results. Red-headed pine sawfly, *Neodiprion lecontei* (Fitch), is increasing in Vermont plantations; extensive defoliation occurred on white pine in Massachusetts and on jack pine in Minnesota. Excessive rain may have been responsible for the decline of the jack pine sawfly, *N. pratii banksianae* Rohwer, outbreak which has persisted for the past 10 years. The loblolly pine sawfly, *N. taedae linearis* Ross, reportedly caused moderate to heavy defoliation throughout southwestern portions of West Virginia, widespread but limited defoliation in Pennsylvania, and no damage in Illinois. A 20,000-acre infestation of the red-pine sawfly, *N. nanulus nanulus* Schedl., in Wisconsin collapsed. Feeding of the birch leaf miner, *Fenusa pusilla* (Lepelatier), caused extensive browning in New Hampshire, Vermont, Rhode Island, central Wisconsin, and the Upper Peninsula of Michigan. *F. ulmi* Sundevall, the elm leaf miner, heavily infested elms in central Wisconsin. The tip moth, *Rhyaciona adana* Heinrich, infested about 15 percent of red pine nursery stock at Watersmeet, Mich.

Status of Diseases

Dutch elm disease, *Ceratocystis ulmi* (Buisman) Moreau. This widespread vascular disease is now present in 70 of Wisconsin's 72 counties and has appeared in many areas of upper Michigan, a dramatic increase in the past 2 years. Devastation continues in the New England States. Control measures, such as sanitation, root pruning, and spraying are applicable in urban areas but not under forest conditions. Salvage of infected trees in upland areas and liquidation of merchantable elm on bottomland sites appear to be the most suitable actions for the present.

Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt. Oak wilt continues to be a problem throughout most of the Northeastern Area States. West Virginia reported about a 5 percent increase in diseased trees, which is within the normal annual variance. The fungus continues to kill large numbers of oak in central Wisconsin where root grafting is common in dense stands. Unusual numbers of white and bur oaks were killed in Wisconsin.

Red pine shoot blight, *Sirococcus strobilinus* (Desm.) Petr. This disease of red pine in the Lake States has spread little from 1972 survey. Surveys indicate a general increase in tree killing in infected stands.

Scleroderris canker, *Scleroderris lagerbergii* Grem. Young red pine stands in northern Wisconsin continue to be infected with Scleroderris canker. Branch mortality is usually confined to the lower whorls. Red pine growing on poor sites, under highly stressed conditions, again sustained mortality. Site selections appear to be the best control. Local spread was noted in the Adirondack region of New York. Nursery stock at Watersmeet, Mich., is being treated with chlorothalanil to meet sanitation standards.

Lophodermium needlecast, *Lophodermium pinastri* (Schrad ex Hook) Chev. Lophodermium needlecast was found on approximately 1,200 acres of Scotch pine Christmas tree plantations in central Wisconsin. A survey of the principle Christmas tree producing area in Minnesota indicated about one-third of the stands were moderately to severely infected. Spanish and French varieties of Scotch pine were most severely affected. Growers treated approximately 700 acres. Pennsylvania destroyed about 355,000 infected seedlings in State nurseries. West Virginia reported needlecast on Scotch pine to be Statewide.

Anthracnose, *Gnomonia* spp., *Gloeosparium* spp. and others. An increased occurrence of anthracnose was noted this year, resulting from a prolonged wet spring. It was reported in most States with occasional, complete defoliation. Red maple, sycamore, and black walnut were severely affected; however, there is little concern in the forest areas.

White pine blister rust, *Cronartium ribicola* Fisch. White pine blister rust continues to be reported along the Pocahontas-Greenbrier County line in eastern West Virginia. Control work is limited to ribes eradication. In the Lake States, pathological and silvicultural pruning are combined to protect stands growing in the high rust hazard zone. Rust-resistant selections of eastern white pine are now being tested in the Oconto Seed Orchard, Nicolet National Forest, Wis.

Beech bark disease caused by a sequence of the beech scale, *Cryptococcus fagi* Baer., followed by infection with the bark fungus *Nectria coccinea* var. *faginata* Loh., continued its annual destruction of millions of board feet of American beech in the New England States, and spread into New York and Pennsylvania. In New York, the disease took a big jump to Allegheny County. On National Forests in Vermont and New Hampshire, beech is now managed as an undesirable species largely because of beech bark disease. Stands are being salvaged with regeneration aimed at maple and birch.

Diplodia twig blight, *Diplodia* spp. This disease occurred from northern Vermont to New Jersey on hard pines. It is particularly severe on Austrian pine in New Jersey where it has affected nursery seedlings, but is most damaging on mature trees. Uninfected trees over 1 foot in diameter are rare, with mortality frequent within 5 years of initial infection. Because of this severity, forest pest authorities are advising against further planting of Austrian pine.

Aspen shoot blight and leaf spot, *Venturia* spp. Shoot blight and leaf spot caused by the same fungus was prevalent in most aspen stands in Wisconsin and was particularly damaging in newly regenerated clearcuts. Many trees acquired a bronze color by late August and the leaves fell prematurely. Shoot blight appears to be a major cause of forking in young aspen stands.

Miscellaneous Diseases

White pine root decline, *Verticicladiella procera* Kend., is reported to have reached damaging proportions in many widely scattered Christmas tree plantations in West Virginia. Root rot caused by *Fomes annosus* Fr. (cke.), remains severe in many conifer plantations of southern New England and mid-Atlantic States. Low vigor red spruce of merchantable size are being killed by the shoestring root rot fungus, *Armillaria mellea* Vahl ex. Fr., in the Green Mountains of Vermont. Pines and spruces in Wisconsin's forest tree nurseries were affected by Cylindrocladium root rot, *Cylindrocladium scoparium* Morgan. Jack pine stands in the southern and central parts of Wisconsin were commonly infected by the needlecast, *Davisomycella (Hypodermella) ampla* (Dav.) Dark. In Minnesota and along the coast of Maine, dwarf mistletoe, *Arceuthobium* spp., caused severe damage in localized areas. Present control practice is limited to burning slash after harvest or salvage cut. Brown spot needle blight, *Lecanosticta acicola* (Theum.) Syd., a problem with Christmas tree growers appears static in Wisconsin; fungicide sprays were applied. Infection by *Puccinia spp.*, causing a leaf rust on ash, resulted in serious defoliation for the third year in Maine and New Hampshire. A needle rust of balsam fir caused by *Uredinopsis* spp. was present in Christmas tree plantings in Vermont and New Hampshire. Salt damage was especially severe on hemlock, pine, spruce, and some maple and birch through the Northeastern area.

Air pollution. Tip burn and chlorosis of pines resulting from sulfur dioxide (SO_2) and ozone (O_3) pollution was reported in Pennsylvania and West Virginia. In Pennsylvania, SO_2 pollution was widespread with an increase of 10 times the damage reported in 1972. In the north central part of the State, 70 percent of the white pines were affected, with mortality apparent in mature stands. A 10-day air stagnation period over Mt. Alto, Pa., caused tip burn of current needles, chlorotic mottling, and premature needle drop of selected Virginia pine nursery stock; Norway spruce was also affected.

West Virginia reported SO_2 pollution causing severe tip burn on about three million seedlings in the State nursery. On the National Forests in Missouri, about 400 acres of oak showed leaf burn symptoms from sulfuric acid mist and SO_2 emissions in the vicinity of a lead mine.

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Red pine shoot blight	50
Rhabdocline pseudotsugae Syd.	27
Rhizina root rot	11
Rhizina undulata Fr.	11, 12
Rhizoctonia solani	45
Root diseases	25
Root rot	51
Roselinea herpotrichoides Hept. & Dav.	16
Rusts	32, 37
Salt damage	17
Scirrhia acicola (Dearn.) Siggers	27
Scirrhia pini Funk & Park.	32
Scleroderris canker	50
Scleroderris lagerbergii Grem.	50
Sclerotium bataticola Taub. (Davis)	45
Septobasidiun curtisu	46
Sirococcus shoot blight	6
Sirococcus strobilinus (Desm.) Petr.	6, 17, 50
Spruce needle rust	6
Stem decays	25
Stereum sanguinolentum (Alb. and Schw. ex Fr.) Fr.	25
Sycamore anthracnose	46
Taphrina sp.	32
Tuberculina maxima Rostr.	32
Unidentified canker of Douglas fir	13
Uromyces koae Arth.	17
Verticicladiella procera (Kendrick)	51
Venturia spp.	51
Verticicladiella wagenerii (Kendrick)	16
Western gall rust	13
White pine blister rust	44, 51
White pine foliage disease	45
White pine root decline	51
Winter damage	27
Winter drying	7, 12

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